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ON THE DEVELOPMENT AND COURSE OF THE MEDULLATED FIBRES IN THE CHIASM OF THE OPTIC NERVES IN MAN.

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IN examining a series of human embryonic eyes some years ago, I was struck by the fact that in the optic nerve, some millimetres distant from the lamina cribrosa, the fibres appear as simple axis-cylinders without a medullary sheath. Even in the eyes of infants born at term, which have died at birth or shortly after, no medullary substance is found in this location, but naked axis-cylinders alone, such as are found in adults only anterior to the lamina cribrosa. This fact, not mentioned in the literature, led me to study the matter thoroughly, and to follow more accurately the development of the medullary sheath in the fibres of the optic nerve and chiasm in man, as far as my limited material would permit, with a view of determining when and where the axis cylinders of the conducting apparatus of the retina first take on their medullary substance.

The time and place of the first development of medullary substance were determined with certainty, and the successive stages of development were followed in their order from the optic tract through the chiasm to the lamina cribrosa.

The question whether there exists a total or a semi-decussation of the fibres of the optic nerve, after having been dis-

cussed for decades, remains to-day unsettled. The most varied methods of investigation have been employed to prove the one or the other theory, and we should certainly welcome a new method which would enable us to explain the many direct contradictions of authors, and the various sources of error in other methods, and finally give us the purely anatomical proof, which still fails, of the existence of the uncrossed bundle.

All these requirements would seem to be met by our method, which consists in following the formation of medullary substance in the retinal conducting apparatus in man, from its earliest beginning to its full development, by means of Weigert's method of staining.

The solution of the following questions will be attempted in this paper:

1. When and where in the retinal conducting apparatus do the naked axis-cylinders take on their medullary sheath?

2. What is the course of the medullated fibres in the chiasm of the embryo and infant?

I.—DEVELOPMENT OF THE MEDULLATED FIBRES.

In determining the time and place of the first formation of medullary substance a great number of human embryos were studied, which, after the cranium had been opened, were placed as early as possible in Müller's fluid, in which they remained from six weeks to several months. Most of the embryos of the second third of intra-uterine life had lain in Müller's fluid longer, as they had been collected earlier for another purpose by my colleague, Dr. C. Hess, who kindly put them at my disposal. For the remainder of the material, consisting of aborted embryos, new-born and young infants, I am indebted to the Heidelberg Pathological Institute, Professor Weigert in Frankfort, and Dr. Winter in Berlin. The age of most of the embryos was known, and the age of the others was computed from their length. The youngest measured 12–13 *cm*, and from this the series extended to infants in the second, third, and fourth weeks of extra-uterine life.

After lying in frequently changed Müller's fluid for not less than four weeks, the specimens were placed in alcohol sixty per cent., and later eighty per cent., until the alcohol, which was changed daily, showed no longer a yellow color, the vessels remaining during this entire period in the dark. After being left for twenty-four hours in absolute alcohol, the specimens were imbedded in celloidin in the usual manner. They should not be brought from Müller's fluid into water first, for the water not only extracts the excess of chromic acid, but probably also redissolves a portion of the reagent which has penetrated into the tissue, so that it can never be said with certainty whether a negative result from Weigert's stain is to be ascribed to the actual absence of a medullary sheath or to the incomplete hardening of it. When the specimens are not put into water, but are immediately rehardened in alcohol in the dark, the slightest traces of medullary substance will be shown by Weigert's stain.

Dispensing with water and treating the specimens with alcohol has the additional advantage that the precipitates, which otherwise often confuse the stained preparations, are not formed. These niceties in technique are well known, it is true, but they need to be expressly emphasized, as their observance is of very great importance in such investigations.

The specimens, after being imbedded, are placed in neutral acetate of copper solution in an incubator for forty-eight hours, then cut with a microtome in thin serial sections, stained with Weigert's hæmatoxylin for twenty-four hours, washed quickly in distilled water, and carefully decolorized. It is well to dilute the differentiating fluid, as this prevents a too hasty decolorization, and the more gradual process can be better controlled. The sections removed from the differentiating fluid are put into water, in which they may remain for hours, and then for a few minutes into alcohol, 90%. They should not be left long in the latter, as they become pale, and traces of medullary substance or delicate young medullated fibres may easily be overlooked. Finally, after being cleared in origanum oil, the sections are mounted in Canada balsam.

A marked variation in color, in sections from specimens which are fresh or which have been hardened in Müller's fluid, is observed only after the formation of medullary substance is far advanced. During the whole of embryonic life, and even in infants dying at the time of birth or a few hours after, there still predominates that indefinite, hyaline, gray to reddish-brown color of the soft, almost jelly-like tissue.

Before the twenty-fifth week of embryonic life no clearly recognizable chiasm appears. In the early periods no medullary substance is found. The axis-cylinders are developed but are small. Actual connective-tissue fascicles are not clearly recognizable between the bundles of axis-cylinders, but faintly stained connective-tissue corpuscles with processes and well-marked nuclei are seen arranged in rows, and between these there are indications of connective-tissue fibres. In this young tissue great numbers of the finest capillaries are found, which run longitudinally in part, and in part form transverse anastomoses. In reality a capillary network exists, through which the finest axis-cyinders pass.

Connective-tissue septa form a close network through the optic nerve in its entire course. These septa are very rich in apparently free-lying cells, to which as well as to the numerous capillaries they owe their vitality. At some points these spindle cells seem to be in connection with the walls of the finest capillaries, and are therefore to be considered vascular sprouts.

Lack of material between the eighteenth and twentieth and the twenty-eighth and thirtieth weeks of embryonic life made it impossible, unfortunately, to follow the various form-elements in the chiasm through every stage of their development.

In all the specimens examined, the chiasm together with the tract as far as its free root and the nerve as far as the optic foramen were cut in horizontal serial sections.

Sections of the chiasm of an embryo of the twenty-eighth to the thirtieth week, stained by Weigert's method, appear of a uniform pale-yellow color when slightly magnified, and show a delicate longitudinal striation, which in the middle of the

chiasm becomes more netlike. Running in the same general direction with these delicate striæ are seen dark-brown or black stripes, which, while interrupted in many places, are on the whole regular. The substance connecting the two inner longitudinal sides of the tract and the posterior angle of the chiasm is of a fairly uniform bright yellow color, shows no striation, and is somewhat granular.

Under a higher power the finely striated ground-substance of the tract resolves itself into sharply defined single fibres, which run beside each other, interlacing to some extent, but always pursuing a direction parallel to the long axis of the tract. The individual fibres do not unite to form bundles. They are separated from each other by a clear homogeneous cement-substance, and present the appearance of unmedullated axis-cylinders.

In the chiasm the individual axis-cylinders are similar to those in the tract, but the mass presents a different appearance. The fibres cross each other irregularly, and this entanglement is greatest in the central portion of the chiasm, and much less marked near the angles.

In the nerve, the picture is again changed by the characteristic connective-tissue septa, which here, as in the developed nerve, spring from the pial sheath and divide the mass of axis-cylinders into small bundles which partially interlace.

The black stripes seen in the tract, chiasm, and nerve under a low power now appear as fine capillaries, which run through the whole preparation in every direction, but more particularly in the direction of the bundles of axis-cylinders. The great number of leucocytes, in comparison with the small number of red corpuscles, is striking.

Besides these cells, the round or oval sharply contoured black or dark-yellow cells, described above, are found free in the interfibrillar substance, and I am inclined to regard these as belonging to the connective-tissue cells.

Capillaries are found everywhere in the yellow finely granular ground-substance between the tracts, just as they are found in the tracts and chiasm, and there are also seen large dark-yellow or black round or oval cells, with a large round nucleus and a large clear protoplasmic body. These

are the ganglion cells described by J. Wagner 'and Meynert,' which Meynert considers ganglia of origin of the nerve fibres which pass to the nerve of the same side; he therefore calls this region the basal opticus ganglion.

At the thirtieth week of embryonic life, the chiasm under a lower power presents a picture similar to that found in the other case. It is difficult, in the entanglement of pale fibres, to recognize with certainty the continuation of any particular fibre. At this time a substance begins to appear about the naked axis-cylinders, of a different chemical composition from them, and distinguished by its dull-gray color. In other parts a number of swellings appear on a single axis-cylinder, while the intervening portions retain their original color. In almost all the sections of the chiasm in this embryo of the thirtieth week, such points were found scattered about, but never affecting more than a small portion of the axis-cylinder, and then only in the tracts and chiasm, never in the nerves.

Two embryos of about equal development were examined, and the two presented a similar picture. The beginning of the formation of medullary substance was seen in both to the same limited extent, without a trace of medullary substance being found in the nerve. This speaks for the constancy of the condition observed.

Sections of a chiasm of the thirty-second to the thirty-third week presented a very different picture. Even under a low power, in certain places in the preparations, besides the darkly stained capillaries and free blood corpuscles, fine darkly-stained fibrils could be seen between the delicate yellow striæ of the axis-cylinders. Under a higher power two things are seen: first, narrow bundles of axis-cylinder fibres, which have the same dull-gray color that was seen in the axis-cylinders in the sections described above, and are as short as those, having two or three delicate swellings, and passing over, for the most part, into naked axis-cylinders; second, near the first, dark-blue sharply contoured fibres, clearly thicker than a naked axis-cylinder, and having also a number of swellings of varying size throughout their whole extent. The greatest number of the medullated fibres is

found in the tract, but scattered and not confined to any particular region. They become rarer nearer the nerve, and are not found at all in the neighborhood of the optic foramen.

In the region of the gray matter which bounds the posterior angle of the chiasm, black arched fibres are found, which are no doubt the medullated fibres of Meynert's commissure, that runs in an arc in the gray matter along the two tracts and the posterior angle of the chiasm. The preparations now to be described were from an eight-months' fœtus which died seven days after birth. It was thus of about the same age as the embryo of the thirty-second to the thirty-third week just spoken of, with the difference that the last week had not been passed in the uterus.

Macroscopically nothing characteristic was found, but microscopically a marked difference between this and the previous specimens was noticed. Under a low power all the sections of the chiasm showed a far more extensive black striation than was found in sections from the previous case. Under a higher power a corresponding increase was seen in the number of medullated fibres in the tracts, chiasm, and nerves. While the optic nerves of the unborn fœtus of the same age showed only traces of medullary formation here and there in their lower portion, in this case the medullary substance was in an advanced stage of development. In the lower portion of the nerves, the axis-cylinders were at least as fully covered by a medullary sheath as those of the tract in the previous case. The anterior angle of the chiasm in some preparations has delicate medullated fibres running in a commissural direction. Meynert's commissure is especially rich in medullated fibres, which here show the most advanced development not only in number, but also in the appearance of the individual fibres, which are thicker than the medullated fibres of the tract and chiasm in the same individual. The angles of the chiasm have more medullated fibres than the interior. Even in the new-born infant the medullary substance of the nerve is much more delicate than that of the tract, and does not extend forward to the lamina cribrosa.

The chiasm of the new-born infant is to be considered a

nervous organ incompletely provided with medullated fibres, for while the greater number of axis-cylinders in the tract, chiasm, and nerve have a medullary sheath, there are still a certain number of naked axis-cylinders scattered among the medullated fibres. The organ is also incompletely developed, since the formation of medullary substance does not extend to the lamina cribrosa, its peripheric limit in the adult.

The youngest individuals studied that had enjoyed extra-uterine life were infants from three to four weeks old.

In these, the medullary sheaths in the nerves extended to the lamina cribrosa. Sections through the chiasms of these subjects presented a remarkably fine and clear picture, which will be described in greater detail later. All the axis-cylinders, as far as could be told with certainty, exhibited medullary sheaths, which appeared young, however, and, compared with those in the adult, were thinner and more delicate, and showed a greater number of swellings. Besides this, free cells are still seen in the interstices of the chiasm, which are formed of apparently structureless interstitial substance (neuroglia). The delicacy of the medullary sheaths makes the topography of the section clearer. As the sheaths have not the thickness which they have in the adult chiasm, an appreciable interspace exists between the individual fibres, and since the general network of the medullated fibres is a loose one, the individual fibres are, as it were, isolated. In sections of the adult chiasm, on the contrary, the fibres have a thicker, less delicate sheath, with very small swellings. On account of this increased thickness of the sheaths in the adult chiasm, the individual fibres are so pressed together that the free spaces between them, so clearly seen in infancy, either vanish entirely or become reduced to a minimum, so that it becomes impossible to follow single fibres distinctly or to isolate them in the chiasm. This may be said to be the chief characteristic of the young chiasm.

The facts discovered with reference to the manner and the time of the first development of the medullary sheaths in the chiasm, may be briefly stated as follows:

No trace of medullary substance can be found in the chiasm or in its roots and processes before the twenty-ninth week of embryonic life. At this time the first beginnings of its formation are seen in the delicate swellings on the axis-cylinders, and these stain dark and often show dark-stained processes on both sides of the axis-cylinder. The processes from two such swellings on a fibre may often be seen to join.

In the thirty-second to the thirty-third week, swellings and their prolongations are seen on a far greater number of fibres, and these portions are stained dark. These swellings are more numerous in the fibres of the tract, and become rarer toward the nerve, ceasing altogether in the nerve trunk. The most marked changes in the chiasm are in the two lateral and the posterior angles, the position of Gudden's commissure and the so-called anterior commissure.[1]

In an embryo of equal age, where the last week of life had been extra-uterine, the influence of this extra-uterine life on the development of medullary substance after the thirty-second week, previously pointed out by Flechsig, was confirmed by the microscopic proof of the more advanced development of the medullary sheaths. This case exhibited the transition to the mature fœtus, in which the tract and chiasm have a greater though not the full amount of medullary substance. The lack of complete development is shown not only by the thinness and delicacy of the medullary sheaths, which are just visible under a low power, but also by the presence of a number of still naked axis-cylinders, and by the fact that the medullary substance ceases some distance behind the lamina cribrosa, while the ciliary nerves at this point in the same eye are made up almost altogether of medullated fibres.

The fibres of Meynert's commissure in the gray matter of the tuber cinereum show the most advanced development in

[1] Michel,[8] in a child in the thirty-second week of uterine life, dead seventeen hours after birth, found the medullary sheaths well developed in the fibres which form Gudden's commissure at the dorsal margin of the chiasm and the tracts. Very delicate medullated nerve fibres, recognizable by their pale gray color, were also seen in the nerves and chiasm. The number of these fibres was greater in the tract, and the extreme lateral bundles in the chiasm seemed to have more medullary substance.

the embryo of the thirty-second to the thirty-third week, and this advanced development continues throughout the succeeding stages of embryonic growth.

In the chiasm of the infant of the second to the third week, all the axis-cylinders possessed a medullary sheath in their whole extent; the young chiasm is distinguished, however, by the fact that the medullated fibres are thinner and more delicate than in the adult, and that the meshwork, as far as it may be considered such, is much looser, permitting the naturally isolated fibres to be more readily followed in their course.

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II.—COURSE OF THE MEDULLATED FIBRES.

The course of the medullated fibres in the chiasm in man has long interested physiologists, anatomists, and ophthalmologists.

In 1826 Johannes Müller,[1] without anatomical grounds, at a time when there were no means of following the course of single nerve fibres, advanced an hypothesis which attempted to explain the problem of single vision by assuming the existence of identical points in the two retinas. He suggested that each root-fibre of the tract might divide in the chiasm, and the two branches end in corresponding points in the two retinas. Two years later he saw that this hypothesis was untenable, for it had been discovered that the fibres pass undivided through the chiasm, and that, therefore, the combination of the impressions must take place through

some special arrangement in the central organ proper. Each root of the chiasm must then carry the fibres from the corresponding halves of both eyes to the brain. He assumed that in man and animals, where the horopters coincide in part, the outer fibres of the tract pass to the nerve of the same side, the inner fibres to the nerve of the opposite side, and he thought also that he had seen commissural fibres between the peripheric and central origins of the nerves.

Two years before this, Treviranus,[3] studying the monkey's chiasm hardened in alcohol and exposed for a time to the action of caustic potash, found that after the sheath had been removed and the fibres separated by means of fine needles and a brush, the fibres in the upper outer portion of the nerve appeared to pass from the brain to the eye without anastomosing in the chiasm with the fibres of the other nerve; while the fibres of the inner lower portion of each nerve passed over in the chiasm to the nerve of the opposite side, and became intermingled with its fibres.

F. Arnold[3] arrived at similar results after isolating the fibres in the human chiasm, and the drawings in his famous "Tabulæ Anatomicæ," 1839, were apparently conclusive.

In 1831 Hilderbrandt,[4] in his "Anatomy of Man," presented a number of observations of a pathological nature, supporting the idea of a partial crossing, and he was followed by Longet,[5] 1842; Foville,[6] 1844, and Cruveihlier,[7] 1845. The first spoke of the macroscopic appearance in a case of unilateral atrophy of the optic nerve, where the difference in thickness in the two tracts did not indicate a total crossing. The others studied also the course of the fibres, and Cruveihlier, while he did not mention an anterior commissure, described a posterior one, which was probably that discovered later by Meynert.

The first investigations of importance concerning the course of the fibres in the chiasm were made by Hannover[8] in 1852. He found that when the chiasm and tract were left some months in a weak chromic-acid solution, the separate bundles of fibres could be isolated.

Experimenting with this method, Hannover distinguished the following bundles: (1) A commissura ansata, composed

of fibres which descend from the lamina terminalis cinerea, situated before and above the chiasm, and which run superficially first on the anterior and later on the inferior surface of the chiasm, and are finally lost posteriorly in the tuber cinereum and the infundibulum. (2 and 3) A fasciculus sinister et dexter, which run, one on each side, mostly in the outer border of the chiasm; they are also seen on the upper and lower surface of the chiasm, but do not reach to the middle line. Passing forward, the fibres are directed outward and downward, the upper fibres in the tract becoming thus gradually outer fibres, and further forward toward the chiasm the outer fibres become lower fibres. (4) A commissura arcuata anterior, forming an isolated arched bundle $\frac{3}{4}'''$ thick, which lies on the anterior concave margin of the chiasm, and sends a branch forward in the inner border of each optic nerve. The greater number of the bundles lie near the upper surface of the chiasm. Erdl[9] had already called attention to this bundle in 1843. (5) A commissura arcuata posterior, which lies superficially at the posterior concave margin of the chiasm, and forms an isolated bundle. As the fibres run from the brain to the chiasm, they pass upward, and thus take part in the turning of the fasciculus dexter and sinister. (6 and 7) A commissura cruciata, which, next to the commissura ansata, contains the smallest number of fibres, and is but $\frac{1}{2}'''$ thick. One bundle passes from the right side to the left optic nerve, and the other passes in the opposite direction. It lies in the interior of the chiasm, apparently nearer the upper surface. This commissure is very difficult of demonstration, because of the intimate blendings of the bundles and fibres. All these grosser divisions are made up of smaller bundles, which lie near each other without mingling, except in the case of the commissura cruciata. These discoveries of Hannover's were verified in 1854 by Sohmen[10] by means of microscopic sections, and the question seemed to be settled.

But, six years later, a paper was published by Biesiadecki[11] on "The Chiasm of the Optic Nerves in Man and Animals," in which methods of investigation, similar to

those of Hannover, lead to results almost contrary to his. The work had been performed under Brücke's direction, and this fact gave it special weight. It closed with the words: "After my investigations, I must agree with those who have supposed that a complete crossing of the optic fibres takes place in the chiasm in man and in all vertebrates."

His method was, first, the microscopic examination of sections from specimens hardened in chromic acid; secondly, the examination of teased chiasms hardened in chromic acid and laid in concentrated potash solution, whereby the connective tissue between the nerve bundles became partly more transparent, and partly dissolved, so that the bundles could be separated without difficulty. Finally, chiasms of men and animals blind in one eye were examined in a similar manner. In man he found that the commissura ansata of Hannover existed, but was composed, as Valentin[19] had said, of tendinous fibres. "On the upper surface of the chiasm the fibres are seen to run continuously from the nerves to the posterior angle of the chiasm; the lower fibres of the nerve pass on the upper surface to the opposite root, the outer fibres, however, cross first in the angle and run in the root from inward, outward, crossing the other fibres of the root. In some chiasms I found a striking departure from this rule, in that the fibres from the nerve extended in a process becoming ever thinner, having an inner convexity and an outer concavity, and ended in a point at the side of the posterior angle at the chiasm. The fibres of these processes seemed to remain on the same side." The lower surface is similar to the upper in that the same process takes place, but in a reverse order. If the nerve bundles are removed separately from the chiasm, well preserved specimens give pictures which show the complete crossing of the root fibres to the opposite nerves. Preparations less well preserved often show bundles which seem to remain on the same side, but when these are examined with the microscope, they are seen to be crossed fibres, which have been torn off after the crossing. The fibres which seem to run in a commissural direction also reveal themselves to be fibres crossing in a slightly curved arc.

Brown-Séquard's[13] studies were in the direction of experimental pathology, and depended upon the cutting through of the chiasm of animals in the median line, after which total blindness resulted. This indicated a total crossing, but could not strictly be considered as holding good for man.

In 1873 Mandelstamm[14] repeated the experiments of Biesiadecki on the human chiasm, but isolated the bundles more in layers, so that the course of the fibres could be followed in different planes.

"In following the fibres of the tract in the upper surface of the chiasm, the extreme outer ones are seen to pass to the outer angle, and there turn to the lower surface and cross. This relation is best seen in chiasms with acute outer angles. These are the fibres which in sections are seen to cease at the outer angle of the chiasm, as if cut off, and seem not to exclude the possibility of the existence of a lateral commissure."

After removing the upper layers, fibres are found in the middle layers which describe an arc. "These fibres of the middle layers of the chiasm, because of their arched course, may simulate anterior and lateral commissures, especially the latter. The isolation of the bundles will alone show the actual relation. Their horizontal sections are also of value, and those especially from the upper surface exhibit a total crossing of the fibres."

The same year Michel[15] employed horizontal sections, and his conclusions were that in the chiasm of man all the optic-nerve fibres cross, and no trace of commissures can be found within the chiasm.

Michel's results found a speedy confirmation in a paper by Scheel,[16] who used not only horizontal sections, but also divided the chiasm in a sagittal plane, and then made wedge-shaped sections from the left half, the base of which came from the anterior angle of the chiasm, and further from the left nerve. The right half was cut in a similar way. In spite of this complicated proceeding, he came to the conclusion that all the fibres cross, and that no commissures exist. He verified by this method the existence of fibres which

spring from the tuber cinereum and the lamina terminalis cinerea and run in the upper and lower surface of the chiasm, but not in the chiasm itself, and he acknowledges that these fibres pass in part to the side next them and in part form the commissura ansata.

The contributions which Gudden[17] then made to this very involved subject were of great importance. He brought the experimental method of investigation in animals to the highest degree of perfection. He also studied the human chiasm in horizontal sections, yet, as he says, this must be rightly done. Definite results can be obtained only by following section for section, bundle for bundle. "Michel does not seem to have done this. His drawings are correct, but not convincing. If he had had a complete series of sections, he might have made just as beautiful drawings to prove that the crossing is not complete, and that the view of Hannover-Henle,[18] that ‚a lateral direct fascicle exists, is correct." Gudden denied the existence of an anterior commissure. He supported the idea of a direct bundle, but added that the fibres which cross lie mostly in the lower half of the chiasm, and those which do not cross, in the upper half.

Gudden also measured transverse sections of the tracts and nerves in dogs where one eye, or both, had been enucleated, and did this also in human chiasms where unilateral atrophy had existed. These measurements confirmed the idea of a partial crossing. All of Gudden's results were verified by M. Reich, in the *Centralbl. f. med. Wissensch.*, 1875, p. 480.

Adamük[19] produced unilateral atrophy in new-born cats and dogs by enucleating one eye. Study of the chiasms and tracts some months later showed that the crossing in these animals is not complete. In addition, he gave a macroscopic description of two human chiasms where one eye had been lost in infancy. The measurement of transverse sections of the nerves and tracts gave results which could only be explained by the assumption of a semi-decussation.

Purtscher[20] studied the nerves, chiasms, and tracts in six cases of unilateral atrophy of the optic nerve, and three cases of bilateral atrophy. The eyes in most of the cases had

been blind for years. The sections of the six cases of unilateral atrophy verified all of Gudden's important results. Two cases of bilateral atrophy showed the commissural system discovered by Gudden, *i. e.*, the posterior commissures of Gudden and Meynert, as an isolated bundle of normal fibres in the otherwise totally atrophic tracts. The sections were studied partly in glycerin or solution of caustic potash, partly stained with carmine after previous treatment with palladium chloride.

Baumgarten's [21] microscopic examinations of human chiasms with unilateral atrophy were not less conclusive of a semi-decussation.

Stilling [22] in 1882 resumed the former method of isolation of the bundles, but macerated and dissolved the connective tissue by means of alcohol and pyroligneous acid. His results favored the idea of a partial crossing.

A series of investigations of pathological cases now follow (Marchand,[23] Richter,[24] Nieden,[25] and others), in which unilateral or bilateral atrophy existed in consequence of the loss of one or both eyes. These were examined microscopically in part, macroscopically in part, or the measurements of the transverse sections of the nerves and tracts were compared (Deutschmann,[26] Samelsohn [27]). The results indicated a semi-decussation.

Kellermann's [28] investigations are worthy of special notice, as he treated his sections of the chiasms with two reagents hitherto unused—gold and osmium. From his examination of the chiasm in a case of unilateral atrophy, he was led to regard the crossing as incomplete. He did not accept the view, however, that the direct bundle runs separately by itself, but that fibres scattered everywhere through the nerve pass into both the crossed and uncrossed bundles. The case was not altogether convincing, as the nerve on the side where vision remained showed a partial atrophy.

The numerous experiments on animals, first made by Gudden [29] and imitated by his pupils and others, are interesting in a high degree, as they are conclusive of the fact that there is a semi-decussation in a number of mammals, such as the rabbit, cat, and dog.

We shall not go into a detailed discussion of these experiments, as this had been done a number of times by others, and for the further reason that here where the question is in regard to the course of the fibres in man, these experiments have no direct application. It is not going too far to suppose, however, since the higher developed mammals show a more complicated arrangement of nerve fibres indicating a partial crossing, that this is probably the case in the mammal of highest development—man. This is, at any rate, an analogy more justifiable than that of Michel, who says: "Since a complete crossing occurs in mammals, it would seem strange if this were not also the case in man."

This is, however, not the case either in man or in the higher mammalia. Gudden,[80] who in 1875 was of the contrary opinion, proved this experimentally for the rabbit in 1879. In his first experiment, after the removal of the posterior portion of the cerebral hemisphere in a new-born animal, the whole base of the brain with the tract was taken out. Six months later examination showed that the injured tract was completely atrophied, the nerve of the same side and the opposite tract were normal, and in the apparently atrophic opposite optic nerve, a thread-like normal direct bundle could be seen after being stained with osmic acid. In the second experiment the frontal bone was removed and one half of the chiasm taken out with a sharp spoon. Examination of the fully developed animal showed nothing in the chiasm excepting the direct bundle of the one side, which could be followed from the optic nerve into the tract of the same side.

These proofs have not satisfied Michel, either of the semi-decussation in mammals or of the semi-decussation in man, which might naturally be supposed to follow from the other.

In an elaborate brochure with fine plates, published in honor of Kölliker's seventieth birthday, Michel[81] repeated his well-known views on the crossing of the fibres in the chiasm of birds and mammals, including man, and hoped thereby, he says, to convince others, not of the theory but of the fact of the total decussation in the chiasm. The main point,

which was new in his manner of investigation, was the use of Weigert's method of staining for the medullary sheaths.

He studied new-born and full-grown owls, guinea-pigs, rabbits, cats, and dogs, and some preparations from man. Serial sections were made with a microtome in a horizontal plane, so that nearly every section included the chiasm, both tracts, and both nerves; transverse and longitudinal sections of the nerves and tracts were also made. The owl's chiasm was obtained from a bird in which one eye showed an opacity of the lens and an atrophy of the nerve of the same side. In the other animals one or both eyes had been enucleated for the purpose of determining the relations of the commissure. In the rabbit some chiasms were divided in a median plane. The examination revealed in every case a total crossing of all the fibres of the tracts.

Besides these, three cases of unilateral atrophy of the optic nerve and a case of unilateral anophthalmus in man were examined. These cases also showed a complete decussation of all the fibres of the tract.

Let us look more closely at the report of these four cases in which the human chiasm was examined.

The first case was that of a man of sixty-seven, who had lost his right eye in early youth. In the whole series of horizontal sections the right optic nerve is seen to contain, in a yellow finely fibrillar tissue, a great number of dark-colored nerve fibres of varicose appearance, which run not in isolated bundles, but as single fibres. A lighter color is seen only in the dorsal portion of the left half of the chiasm, and especially in the dorsal portion of the left tract. The light point in the dorsal portion of the left half of the chiasm shows the interweaving of the fibres as in a straw mat, and the extreme lateral bundle of the right nerve bends in a fairly convex curve toward the tract of the same side before it passes to the opposite side. In the dorsal portion of the left tract a narrow atrophic bundle is seen, directly continuous with the atrophic bundle in the chiasm.

The second case was that of a man of sixty-six, who had lost his left eye forty-six years before. The whole series of horizontal sections showed a marked thinning of the left nerve and the right tract. The tract of the same side shows a normal thickness, and

is composed solely of normal bundles of nerve fibres. The degeneration in the atrophic left nerve is general.

The third case was that of a girl of fifteen, whose right eye was removed on account of gliosarcoma. Five years afterward the left eye showed a choked disc, and death occurred a year later. Nearly the entire left hemisphere of the cerebellum is occupied by a cyst filled with serous fluid ; the lateral ventricles, especially the left, are markedly dilated and filled with fluid ; the right optic nerve is very thin, the left tract is less prominent, but completely white.

" The whole series of horizontal sections shows the right nerve totally degenerated and diffusely yellow, with here and there in some sections a short, darkly stained fibre. The right tract in its entire breadth shows narrow varicose bits of stained nerve fibres, with occasional fibres of larger calibre mingled with a number of bits of medullary substance. The changes are most marked in the dorsal portion, and in some sections in the middle portion, so that a finely fibred yellow tissue presents itself, in which bits of nerve fibre are seen. The left nerve shows degenerated nerve fibres scattered uniformly over its entire breadth, the degree of degeneration however being less than in the opposite tract. The degeneration is again much more marked in the left tract than in the right. In the central portion of the chiasm there is a regular interweaving of completely degenerated fibres and such as show a moderate degree of atrophy."

The fourth case was that of a child with unilateral anophthalmus, who had died when five months old. A carmine stain was unfortunately used. " I can only say that the transverse sections of both tracts showed a normal relation, and that the right nerve appeared stained a uniform red."

Michel concludes from his investigations that the progress of the degeneration of one optic nerve remains localized to the opposite tract. Cases 1 and 2 indicate this clearly. The varying involvement of the fibres of the opposite tract in both cases cannot be denied ; but whether the age of the patient or the nature of the ocular disease influenced this, is a question. Case 3 is more involved. It, however, speaks against the idea of a direct bundle, both in the sense of Hannover (lateral bundle) and in the sense of Gudden (a bundle lying laterally in the tract, and medially in the nerve),

since the degree of atrophy is least marked in the ventral portion of the tract on the side of the enucleated eye.

"Further, as the degree of atrophy in the nerve of the eye not enucleated is less than in the tract of the opposite side, it would seem that the general picture was to be explained as a combination of an ascending atrophy of the left nerve with a descending atrophy of the left tract."

Michel looked for the cause of this uniform degeneration of the nerve corresponding to the eye not enucleated, and of the opposite tract, in the cystoid formations of the brain.

However this may be, it is certain that the case is not a simple, uncomplicated one, and it cannot, therefore, be considered either convincing or disproving. This may be said of case 4 also, in which no degenerated fibres were found in either tract. The cause of this may have lain in the method of staining, as these preparations were unfortunately stained with carmine, and this is insufficient to demonstrate the presence of partially degenerated medullated nerve fibres, especially in transverse sections.

There remain but two of Michel's cases in which the human chiasm was examined, which excite our interest, as *apparently* speaking against the idea of a semi-decussation in man. While even to-day it may rightly be objected to the statement of Gegenbaur's, cited above, that the direct bundle has not been anatomically demonstrated, we may also say with Mauthner: "The examination of preparations of the human chiasm with atrophy of one nerve teach indisputably that a semi-decussation takes place in the chiasm." Michel's cases 1 and 2 seemed destined, however, to weaken the anatomical proof of the semi-decussation. They would seem so, since they are the first pathological preparations of the chiasm which have been treated by a method which has long been considered as especially adapted for distinguishing normal medullated nerve fibres from degenerated ones. I hinted, however, at the Ophthalmological Society in August, 1887, and declared formally at the International Ophthalmological Congress in August, 1888, that these cases cannot weaken the theory of a semi-decussation, much less prove the total crossing. Before going further I would speak in

some detail of my preliminary contribution, and of the preparations which I demonstrated at the two meetings mentioned.

I have already mentioned how in studying the development of the medullary sheaths in the embryonic chiasm, a method suggested itself to me which seemed in the highest degree adapted for following the course of the fibres by means of the development of their medullary sheaths. Weigert's method carefully carried out is the only known method by which healthy medullary substance can be made visible through the characteristic dark color. The difficult part of the process is the decolorizing.

In sections stained after Weigert's method the blood corpuscles also become more or less black, and they remain stained unless the action of the differentiating fluid is too long continued. If the differentiating fluid is allowed to act a somewhat longer time than is required for the unmedullated tissue to assume a yellow color, the blood corpuscles appear of a light-yellow color, like the remaining tissues. If the fluid acts still longer, the medullated fibres lose their color gradually and appear yellow, but of a darker tone than the blood and the other tissues. It is never found that the blood corpuscles remain black after the medullated nerve fibres have lost their color. The chiasm in the adult is only slightly vascular, but in the embryo and in young infants it is excessively vascular. In the tract, chiasm, and nerve, but especially in the gray matter filling the posterior angle of the chiasm, there are numerous microscopic and a considerable number of macroscopic vessels present, which in the young chiasm are distended with blood.

This fact makes it possible to be certain that all the medullary substance present is stained. In the process one need only watch the sections of the larger vessels and leave the specimen in the fluid as long as these vessels remain visible as dark points or stripes. This makes it certain that all the medullary substance is stained. Sections stained in this manner often show small dark precipitates, but since these merely lie on the tissue and are not chemically com-

bined with it, they are easily washed off with distilled water. The specimens, as said before, may remain any length of time in water, but no longer in alcohol than is required for the dehydration. Thus carried out, the method never fails.

Chiasms of the twenty-eighth to the thirty-first week of embryonic life cannot be used for studying the course of the fibres, since the formation of medullary substance is not extensive and is limited to a few points. Chiasms of the thirty-second to the thirty-third week throw considerable light on the question.

If we look through the sections of the lower portion of the chiasm, the isolated medullated fibre bundles are seen to lie mostly parallel in the tract, but as they pass toward the chiasm they lie further apart and intercross under considerable angles. This crossing of the individual bundles is most marked where the nerve and tract pass into the chiasm. At the anterior angle of the chiasm, only such bundles are found as cross under very obtuse angles or possibly not at all. No fibres can be seen to change their direction and pass through the chiasm to the nerve of the same side. The picture is that of a total crossing of the medullated fibres. But in sections above the middle of the chiasm, at first a few, and going further upward a considerable number of fibres are seen which pass to the nerve of the same side. One is convinced that these are direct fibres, since fibres are seen which cross these and those previously described as crossing in a large arc, nearly at right angles.

In thus looking through the serial sections and following the portions of fibres showing a medullary sheath and varicosities, a considerable service is rendered by the light shining bundles of unmedullated fibres in which these medullated portions run; they make it possible to determine the direction of these, while it is, of course, impossible to follow an individual axis-cylinder accurately. It has not been possible, as I stated in my former communication, to follow the unbroken course of a medullated fibre from the tract into either nerve in specimens of this age and of the next older.

I advanced the opinion at that time, that this might be due to the fact that the individual fibres in a bundle interlace, and that therefore a section as thin as 10 μ could hardly strike a single fibre in its entire course.

But he who will take the trouble to make thin serial sections of the chiasm at this stage in its development, and study them section for section, following fibre after fibre, can come to no other conclusion than that **there are fibres in the upper half of the human chiasm which pass directly from one tract to the nerve of the same side.**

The straw mat or basket-like interweaving of the fibre bundles, first correctly described by Michel, can be very well seen in the parts of the chiasm near the nerves in those preparations in which the fibres are but partly medullated. It is seen at once in these incompletely developed chiasms that the fibre groups are so intimately interwoven in this characteristic manner, that a compact isolated course of the fibres, at least in the anterior part of the chiasm and in the nerves, cannot be spoken of. The three sorts of fibres are, certainly, at the points mentioned, interwoven in this basket fashion. In the tract, however, the medullated fibres and the axis-cylinders assume a more constant direction, and only the adjoining bundles cross each other at obtuse angles.

The study of chiasms up to those from infants of the third and fourth week merely confirmed the facts which have been stated. In these chiasms also, the direct fibres could be traced with certainty only in the upper half. In the lower half of the chiasm I have never been able to discover fibres having this course, but here all the fibres have the course which Michel has described for the fibres of the entire chiasm.

What may be said with reference to the relative numbers of crossed and direct fibres? The fact that the lower half of the chiasm contains only fibres which cross, and that the upper half contains both sorts mixed together, warrants us in assuming that **the number of crossed fibres is considerably greater than the number of direct ones.** The question, finally, as to whether the fibres run in a compact bundle, must, after a consideration of the foregoing observations, be answered in the negative.

The existence and the course of the two posterior commissures, Meynert's and Gudden's, has long been clear. Michel even has recognized them. Gudden's commissure lies in the chiasm and is intimately blended with it. The fibres form a narrow bundle, which may be said to bound the inner surfaces of the tracts and the posterior angle of the chiasm. The fibres of Meynert's commissure are of much greater calibre than any medullated fibres in the chiasm, and they lie outside the chiasm in the substantia cinerea of the tuber. Between this and Gudden's commissure, every section which includes both, shows a narrow stripe of gray matter between them.

Finally, I found in the middle of the chiasm, near Meynert's commissure, but clearly separated from this by gray matter, a varying number of small isolated bundles, which consisted of a few loosely joined fibres, and which lay scattered mostly in an oblique direction, back in the substance of the tuber cinereum. I can say nothing as to their origin or their further course. I had the impression, however, that they were in communication with the ganglionic groups which lie scattered through the substance of the tuber cinereum, although I was not able to find a direct connection of any such fibre with a ganglion cell. These are no doubt the same fibres which Gudden described (*Gr. Arch.*, vol. xxv., 1, p. 10), and which he was unable to find connected with particular ganglionic groups.

A word now in regard to the so-called Hannover-Erdl anterior commissure. In the beginning of my studies I believed that I found this in my preparations, but a more careful study of partly medullated sections showed me where I had been mistaken. The fibres which seem to pass unbroken from the inner side of one nerve through the anterior angle of the chiasm to the inner side of the other nerve, and so form a commissure, are only those crossed fibres which meeting the fibres of the opposite side exactly in the middle line of the anterior angle of the chiasm, cross nearly at a right angle and thus simulate commissural fibres. In this point I agree with Michel. The commissura ansata of Hannover did not come within the range of my investigations, since

the surface of the chiasm was not studied. We may assume, however, that these fibres, if they are indeed nerve fibres, stand in no connection with the chiasm.

It is a welcome duty to mention another work of great importance, recently published in vol. lx. "Denkschr. der Naturwissensch. Classe der Kaiserl. Akad. der Wissensch. in Wien." This does not deal directly with the chiasm of man, but with that of the higher mammalia. A new method of staining employed clears up many unsettled questions.

The authors, J. Singer and E. Münzer,[*] have slightly modified a method described by Marchi and Algeri in 1887. When parts of nerve or brain which have been hardened in Müller's fluid are placed for five to eight days in a mixture of Müller's fluid and 1 per cent. osmic acid (2: 1), the degenerated and partially degenerated nerve fibres are seen under the microscope to be stained black, while the normal medullary sheaths are merely stained brown. In this manner a total crossing was found to exist in the dove, owl, mouse, and guinea-pig; while the rabbit, dog, and cat showed a partial crossing; the direct portion of the tract did not appear, however, in the form of a distinct bundle, but fibres belonging to it were found scattered over the entire transverse section of the tract. It was proven for the rabbit, in which the number of direct fibres is fewest, that the scattered direct fibres are found only in the upper sections of the chiasm and tract, just as we have described it in man.

This is apparently in direct contradiction with what Gudden and his pupils found in the rabbit's chiasm, viz., the compact course of the direct bundle. The authors have shown this contradiction to be only apparent, and due to the method employed. Gudden's method was to remove one eye of a new-born animal, after which the nerve and the portion of the tract belonging to it do not develop, and a transparent loose connective-tissue represents all that remains of the organ in question. If now, the rabbit has an uncrossed portion in the tract, which is made up of scattered fibres, as we have shown by Marchi's method, the employment of Gudden's method must give the following result: The scattered nerve fibres of the direct portion of the tract

will be pressed together in the empty space left in consequence of the atrophy in the crossed tract, which latter does not develop after the enucleation of the eye, and thus simulate, to some extent, the existence of a separate isolated direct bundle. Similar secondary displacements have been repeatedly described by Gudden and his pupils in organs treated by his method, and this has been called by Mayser, "topical compensation." Indisputable proof of this hypothesis is furnished by Singer and Münzer. In a number of new-born rabbits one eye was enucleated directly after birth, the second four or five weeks later, and three weeks after this the animal killed and the chiasm examined by Marchi's method. The microscopic examination of the horizontal sections showed that the experiment had been successful.

The right nerve consisted of a narrow band of connective tissue, staining pale-brown by Marchi's method, without a trace of nerve fibres; the left nerve appeared intensely black, as well as the right tract. In the position of the left tract was seen the broad, well-developed, normal, and therefore pale-brown commissure of Gudden, on which lay a very narrow isolated bundle of fibres stained intensely black, and this bundle partly mingled its fibres with that bundle which in the left lateral angle of the chiasm separates from the degenerated optic nerve to pass to the tract of the same side. Similar experiments made on cats were followed by corresponding results. Singer and Münzer, therefore, regard the partial crossing as proven for the rabbit, dog, and cat, and the apparent contradiction of Gudden's statement in regard to the course of the direct fibres as satisfactorily explained. They say further: "The results of our investigations compel us to consider the conclusions expressed in Michel's monograph as incorrect. It would seem to us that the exclusive employment of Weigert's method was the cause of the error, since this method is not adapted for the examination of scattered degenerated fibres. It may be that refinements in technique may possibly enable us to get good results with this method. The reason why the stain is inadequate for this purpose is that the bits of medullary substance arising

from Waller's degeneration stain in the same manner as the normal medullary sheaths, so that the degenerated fibres are not sharply enough distinguished from the normal. Had there been a compact separate bundle in the tract of the animals which Michel studied, Weigert's method would have revealed its atrophy; the degeneration of the scattered fibres which our experiments have shown to exist, must have escaped him." It must certainly have escaped him in man.

My investigations have shown that the direct fibres in man do not lie so compactly together as was formerly supposed. In every section through the upper half of the chiasm, I found them mixed with the crossed fibres. The explanation of Michel's error, which Singer and Münzer have suggested, may be extended to the human chiasm.

I would willingly grant that Weigert's method is responsible for his error; still, I must hold to my previous opinion, and continue to believe that, if Michel had carried out the method of staining properly, and had examined a series of sections of the entire chiasm, some of the sections of the upper half must have shown Waller's degeneration or complete atrophy of some of the fibres. The important point in the technique is to wash the decolorized sections for hours in water, to which a few drops of lithium carbonate solution have been added.

Several years ago I had an opportunity, through the kindness of Professor Weigert, of examining in this way a chiasm with unilateral optic-nerve atrophy, where one eye had been lost in early youth. The sections of the lower half of the chiasm (plate x., fig. 1) presented exactly the picture which Michel has described for the entire chiasm.

The sections of the upper half of the chiasm showed a very different picture (plate x., fig. 2). In this part of the chiasm the nerve-fibres show Waller's degeneration in both tracts, and in many sections very distinctly in the uncrossed tract. In the uncrossed tract, besides fibres with normal sheaths, a number are seen whose medullary substance has in part disappeared, and which is in part in isolated irregularly-shaped bits. Many sections show, toward the inner side of the tract, a quantity of almost totally degenerated

medullated fibres, with bits of medullary substance here and there (plate x., fig. 2*a*). The opposite tract shows many fibres equally atrophic. The nerve corresponding to the enucleated eye was completely atrophic, the other entirely normal. Why there are fibres in both tracts, showing various grades of atrophy, I am unable to say. The examination of this unilaterally atrophic chiasm, however, fully confirms my embryological proof of the semi-decussation, and shows also that Weigert's method is sufficient to demonstrate the direct fibres, provided that it be carried out with the necessary precautions, and that an unprejudiced observer examine every section in a complete series, following each bundle and each fibre.

I would here express my thanks to my honored instructor, Otto Becker, for his assistance in this investigation.

Explanation of the Figures.

FIG. 1.—Horizontal section from the lower (basal) half of the chiasm of a man with atrophy of the left optic nerve. Eye lost in early youth.

N. o. s. = Left optic nerve (completely atrophic).
N. o. d. = Right " " (normal).
T. o. s. = Left tract (normal).
T. o. d. = Right " (atrophic for the most part).
C. M. = Meynert's commissure.
G. c. = Gudden's "

FIG. 2.—Horizontal section from the upper (dorsal) half of the same chiasm.

N. o. s. = Left optic nerve (completely atrophic).
N. o. d. = Right " " (normal).
T. o. s. = Left tract (scattered, completely and partially atrophic fibres).
T. o. d. = Right tract (normal, excepting a few scattered partially atrophic fibres).
C. M. = Meynert's commissure.
C. G. = Gudden's "

FIG. 2. *a*.—A portion of the left tract more highly magnified.

a. Completely and partially atrophic uncrossed medullated fibres.
b. Normal varicose nerve fibres mixed with atrophic fibres.

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THE ACTION OF PRISMOSPHERES AND DECENTRED LENSES.

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(With five figures.)

PRISMS or prismatic combinations are frequently ordered for the relief of muscular defects of the eye, but they are by no means always successful. This is due partly to the great difficulty that is found in exactly determining the relative strength of the ocular muscles, but partly also, I believe, to a want of recognition of their precise action. The text-books to which I have referred for information on this point assume explicitly or implicitly that with a given prism the effect produced on the deviation of the eye is the same, whether it be combined with a spherical lens or not.[1] This is, however, very far from true.

We may examine the action of prisms and their combinations from two points of view, according to the purpose for which they are used. In the consulting-room they are chiefly used to effect an alteration in the position of the eyes, or rather in the direction of their fixation lines, but they are generally prescribed and worn to change the apparent site of objects, when binocular fixation[2] cannot be maintained without their aid. Obviously the angular displacement is the same in either case.

The action of plane prisms, when spherical lenses are not combined with them, is simple enough. If we denote the angle of deviation which the prism produces on a ray of light traversing it

[1] In a small book by Mr. E. Maddox, "On the Clinical Use of Prisms," the difference is pointed out, but no formulæ are given for determining the extent of this difference.

[2] For practical purposes it may be assumed that the visual line coincides with the fixation line—*i. e.*, that joining the centre of rotation with the point fixed, unless the object of observation be very close to the eyes.

in the position of minimum deviation by Δ, the deviation (χ) of the fixation line is equal to this angle Δ, as the accompanying diagram indicates. This is an illustration of the advantage gained by designating prisms by their deviation: it is to be hoped that before long this practice will become universal.

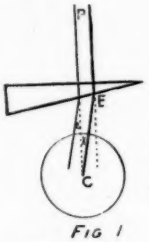

FIG 1

In order to simplify the diagram a rectangular prism, which is not in the position of min. dev., has been drawn; c is the centre of rotation of the globe. The fixation line of an eye directed towards a distant object at P assumes the direction of the line C E after the interposition of the prism. Obviously angle χ = angle Δ.

When, however, a spherical lens is also placed in front of the eye in the normal position, it will be found that with but one exception the angle through which the eye rotates is no longer equal to the angle of deviation of the prism. *Vide* fig. 2.

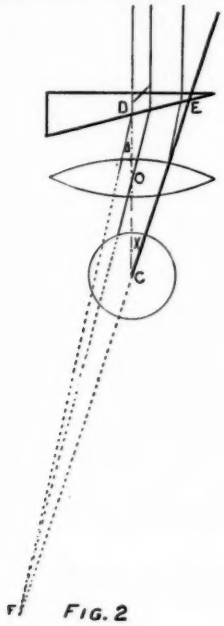

FIG. 2

Let F be the principal focus of the convex spherical lens O. Parallel rays, after traversing the prism, will be deflected through the angle Δ; on encountering the spherical lens they will be rendered convergent, intersecting at a point F on its secondary axis O F. C O is the primary direction of the fixation line. On placing this combination in front of the eye it will rotate through an angle χ, so that its fixation line now takes up the position C E. In the triangle D F C the exterior angle D C E is greater than the interior and opposite angle F D C $\therefore$ χ is greater than Δ.

If the spherical lens be concave χ is always less than Δ. A similar result is obtained when the lens is convex if the object of fixation be within its focal distance; should, however, the object be situated at the first principal focus in front of the eye, the angle χ is equal to the angle Δ. The effect of a plane prism with the object at infinite distance may be regarded as a special instance of this law.

A glance at fig. 3 shows that prismospheres are equivalent to decentred lenses and how prismatic combinations may be expressed in terms of decentred lenses.

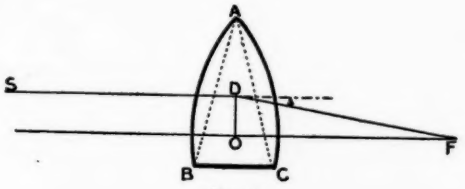

FIG. 3

A B C may be regarded as a decentred lens or as a combination of the prism (marked on dotted lines) with a spherical lens. In the prismosphere A B C, O is the optical centre of the equivalent lens, D is its geometrical centre, O D being the decentration. An incident ray, S D, traversing the point D will be deflected towards the point F, the principal focus of the lens; the angle of its deviation Δ is obviously equal to the angle D F O, $\therefore$ $\tan \Delta = \frac{O D}{O F}$ or $\frac{d}{f}$ where d represents the decentration and f the focal distance of the lens; D represents the power of the lens in dioptries; $\frac{d}{f}$ becomes $\frac{d D}{1000}$. When Δ is small no great error is introduced by considering it proportional to tan Δ.

Then $\Delta = d D \tan -^{1}.001 = d D \times 3'.4375$ [1]—*e. g.*, a decentration of a + 12 D lens to extent of 6.7 *mm* will be equivalent to a prism of 4° 36′ d. (= 6.7 × 12 × 3′.4375).

[1] Even when d D = 120 an error of less than 2′ is introduced.

It will be convenient in studying the action of prismospheres to regard them as decentred lenses and to examine their effect on the direction of the ocular fixation lines. A general formula can then be found by a very simple geometrical method.

FIG. 4

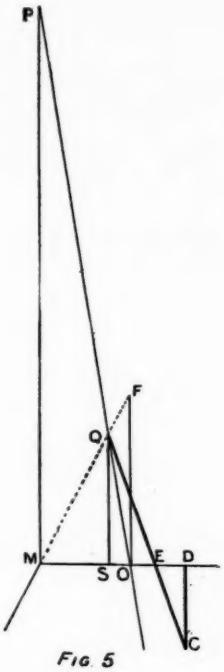

FIG. 5

Let the case of a convex lens be taken first, F being its 2d principal focus, O its optical centre, D its geometrical centre, its decentration therefore is O D, which may be denoted by the symbol d, and may be given the positive sign when the displacement is inwards. Let P be a point situated at a distance M P or p from the plane of the glass, and let Q be its image at distance Q S or q from the glass. Let C be the centre of rotation of the eye at distance D C or k behind the lens. Join QC and produce it to E. Then C E represents the direction of the fixation line for the point P. In fact an eye in order to see P must rotate through the angle P C E after the decentred lens has been interposed. In

practice it is convenient to measure the deviation of the eye from its primary position C D. Let χ (D C E) denote this angular deviation and let it be considered positive when it induces divergence of the visual lines.

Now $\frac{O S}{S Q} = \frac{M O}{M P}$. $\therefore O S = \frac{q}{p} . M O = \frac{q}{p} (M D - d)$, but $S D = O D - O S = d - \frac{q}{p} (M D - d)$.

Again $\frac{S Q}{D C} = \frac{S D + D E}{D E}$, or $\frac{q}{k} = \frac{d - \frac{q}{p} (M D - d) + D E}{D E}$.

$\therefore \tan \chi$ or $\frac{D E}{k} = \frac{d - \frac{q}{p} (M D - d)}{q - k} = \frac{d . \frac{p + q}{p} - \frac{q}{p} . M D}{q - k}$

Now if the incident pencil from P do not strike the lens too obliquely the formula $\frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{p + q}{p q}$ holds good.

$\therefore \tan \chi = d \frac{\frac{q}{f} - \frac{q}{p} . M D.}{q - k}$

On examination of this formula the following relations are obtained :

(i) When p is infinite $q = f$, $\tan \chi = \frac{d}{f - k}$

(ii) When object immediately in front of eye $M D = O$, $\tan \chi = \frac{d \frac{q}{f}}{q - k}$

(iii) On eliminating q from the expression $\frac{d \frac{q}{f} - \frac{q}{p} M D}{q - k}$, $\tan \chi = \frac{d p - f M D}{f p - k (p - f)}$ since $q = \frac{f p}{p - f}$

(a) When the object is immediately in front of the eye, its distance p being equal to f, $\tan \chi = \frac{d}{f}$ *i. e.*, $= \tan \Delta$ where Δ is the deviation produced by the virtual prism.

(β) When p is less than f $\tan \chi$ and therefore χ becomes negative.

(iv) When lens concave, f is negative, thus $\tan \chi = - \frac{d p + f M D}{f p + k (p + f)}$, but if p be infinite, $\tan \chi = - \frac{d}{f + k}$

$\therefore$ If the decentration is positive (*i. e.*, inwards) χ is negative and *vice versa*.

These results may be obtained geometrically, and to ensure recognition of the general applicability of the formula a figure for the case of a concave lens is appended. (Fig. 5.)

A concave lens having its focus at F is decentred to the extent indicated by O D. C represents the centre of rotation of the eye, Q is the virtual image of the point P, C E Q gives the direction of the fixation line. The decentration in this case causes convergence. $\therefore \chi$ is negative.

As before $OS = \frac{SQ}{MP}$. $MO = \frac{q}{p}(MD - d)$, but $SD = OD + OS = d + \frac{q}{p}(MD - d)$.

Now $\frac{SQ}{DC} = \frac{SD - DE}{DE}$, or $\frac{q}{k} = \frac{d + \frac{q}{p}(MD - d) - DE}{DE}$

$\therefore \frac{DE}{k}$ or $\tan(-\chi) = \frac{d + \frac{q}{p}(MD - d)}{q + k}$ but $\frac{1}{p} - \frac{1}{q} = -\frac{1}{f}$ $\therefore q = \frac{fp}{p + f}$

Substituting this expression for q, $\tan(-\chi) = \frac{dp + f.MD}{fp + k(p + f)}$

This expression enables one to determine the degree of ocular deviation produced by a given decentred lens, and conversely one can find out to what extent a given lens should be decentred in order to induce in the fixation lines a given direction.

If the lens be convex, $d = \frac{fMD \pm \tan\chi(fp - k\overline{p - f})}{p}$, the $+^{ve}$ sign being used if divergence is produced, the $-^{ve}$ if convergence.

If the lens be concave, $d = -\frac{f.MD \pm \tan\chi(fp + k\overline{p + f})}{p}$. In this case obviously the decentration must in all cases be negative or outwards, in order to produce divergence.

If the fixation lines are to maintain parallelism $\tan\chi$ becomes O and $d = \pm \frac{f.MD}{p}$.

It will be seen that the increments of *d* will be proportional to the increments of $\tan\chi$; if for instance we were to tabulate the values of *d* for an arithmetic series of values of $\tan\chi$, it would be found that they also formed an arithmetic series. In other words, the tabular differences would be constant.[1]

The formulæ contain four interdependent variables and two constants. Since glasses should be placed in the first principal focal plane of the eye, which is situated 27.4751 *mm* from the centre of rotation of the globe, this value should be assigned to *k*.[2] The distance between the ocular centres has been assumed to be 64 *mm*, this being its usual value in

[1] In mathematical language d is an integral function of $\tan\chi$ of the first degree, its increment therefore is proportional to the increment of its argument ($\tan\chi$).

[2] The value of k is deduced from the dimensions given in Landolt's article in the *Traité Complet d'Ophthalmologie*, vol. iii., pp. 83, 110.

adults; if the object be in the middle line, M D may be replaced by 32 *mm.* I have drawn up a series of tables for reference in this way by assigning their respective values to the variables in these formulæ, the distance of the object being reckoned from the centre of rotation of the globe. The tabular differences corresponding to tan 1° and tan 1 ma have been calculated to three places of decimals.[1]

Table I. is to be used when adaptation of the eyes for distant vision is required, the upper half giving figures for convex lenses, the lower for concave. Suppose a hypermetrope of 8 D present himself, and when his accommodation is relaxed it is found that his minimum convergence is 1 ma—*i. e.*, that his fixation lines intersect at a point 1 metre from him. Since the lens is convex and divergence is required, the decentration must be inwards, and a reference to the table at once gives its amount 3.121 *mm.* Had the patient been myopic to the extent of 8 D with min. convergence of 2°, he would require — 8 D glasses decentred outwards 2 χ 2.661 *mm* or 5.322 *mm.*

In Tables II. and III. the object of observation is supposed to be at $\frac{1}{3}$ *m* from the centre of rotation of the globe—*i. e.*, 305.858 *mm* from the plane of the glasses. Having found what degree of convergence can be maintained without fatigue relatively to the accommodation exerted, it is a simple matter to correct the convergence defect. A patient requiring convex lenses of + 12 D for reading (at $\frac{1}{3}$ *m*) can only maintain convergence for a distance of 1 *m* (1 ma). On reference to Table II. it is at once seen that his glasses must be decentred inwards 6.7 *mm.* Were his spectacles normally centred, more than 4 ma of convergence would be required in order to obtain binocular vision of an object $\frac{1}{3}$ *m* from him. Table III. shows that a myope using —12 D for reading must have them decentred outwards 8.7 *mm*, if he have no power of positive convergence. Binocular vision of the object can then be maintained with parallel visual lines.

The prismatic equivalents have been printed in smaller

[1] Constancy of the tabular differences for angles may be assumed within the limits for which these tables are used. Thus, 10 tan 7° = .174551 = tan 9° — 54'.0767. In this case, therefore, an error of less than 6' is introduced by assuming that angles are simply proportional to their tangents.

type just below the numbers which indicate the amount of decentration for the convenience of those who prefer to prescribe such corrections in terms of prisms rather than as decentred lenses. Thus in the last instance the — 12 D spectacles, decentred outwards 8.7 *mm*, may be prescribed, or, what comes to the same thing, prisms of 5° 58′ d, with their refracting surfaces ground concave to the extent of — 12 D, may be ordered to be mounted in the frames with their edges directed towards the temples. Though in the examples given only errors of convergence have been taken, it is obvious that the use of the tables is not confined to the relief of such defects, but that Table I. at any rate is equally applicable in cases of hyperphoria.

Enough has now been said to explain the way in which prismatic combinations may be correctly prescribed when the muscular object is known. It is hoped that these tables may also prove of service in diagnosing more precisely than has hitherto been customary the relative strength of the ocular muscles.

In examining the binocular function, it is important that the retinal images should be defined, in order to stimulate the desire for fusion. Hence in all cases in which errors of refraction exist, these should be first corrected by appropriate lenses. Thus, in determining the (absolute) minimum of convergence, the patient should first be provided with glasses, which enable him to define some distant object without exerting his accommodation. While his attention is now concentrated upon it, abducting prisms are placed before the glasses; the strongest prism compatible with single vision enables one to discover the minimum of convergence. It is sometimes found that hypermetropes can overcome stronger prisms without the correcting glasses. As an example of this, I may take a case I examined a few days ago. The patient had compound hypermetropic astigmatism:

R. H^m + 4 D sph. ⌒ + 1.5 D cyl. axis | 90°
L. H^m + 2 D sph. ⌒ + 1 D cyl. axis | 90°

With these lenses duly adjusted, the strongest abducting prism held before the right eye that could be overcome was

found to be one of 6° d, but without these glasses binocular vision could be easily maintained with a prism of 6° 30′ d, and momentarily attained with one of 7° d. At first sight it would appear that his power of divergence was greater when he was exercising his accommodation than when it was at rest, but a little further consideration on what has gone before will show that this is not the case. A 6° d prism held before the sphero-cylinder + 4 D Sph. ⊃ + 1.5 D cyl. ax | 90°, will cause an angular deviation of about 7° 3′ in the direction of the fixation line.[1]

The same prism (6° d), when placed before the left eye and its correcting glass, produces only a deviation of 6° 32′. In the case in question, the patient said the prism seemed to strain his left eye less than his right. In many cases, probably, the diverging power will be found to be considerably greater when the accommodation is completely relaxed, and the refraction of the eye adjusted for distance by means of glasses, than when such precautions are not taken. If the ametropia be of sufficiently high degree, the power of divergence may be estimated by altering the position of the glasses, separating them if concave, approximating them if convex. When the decentration and the dioptric strength of the glass is known, Table I. gives the angle of divergence or minimum convergence.

The exact determination of the absolute maximum of convergence is a more difficult matter. The old finger test is a simple, rough method, which has been modified in various ways. Landolt's plan is merely a modification of the same principle, the object of fixation being a line of light, which is gradually brought close to the patient; as soon as the line appears double, the distance from the eye to the object is measured.

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[1] The power of the horizontal axis of the sphero-cylinder is + 5.5 D, and from Table I. it will be seen that a 6° d prism must cause a deviation of rather less than 7° 17′. If greater accuracy be demanded, the formulæ given above may be used. $d = f \tan \Delta = \frac{1000}{5.5} . \tan 6° = \frac{105.1042}{5.5} =$ 19.11, the effect on the direction of the fixation line is therefore $\tan^{-1} \frac{19.11}{f - k} =$ $\tan^{-1} \frac{19.11}{181.81 - 27.4751} = 7° 3'$ approximately.

Much can be said in favor of this method; its simplicity the readiness with which the test can be applied, and the short time the examination occupies, recommend it strongly both to doctor and patient. There are, however, some serious objections to its use; I believe it indeed to be quite unreliable in cases of hypermetropia. When the point of fixation falls within the binocular near point of accommodation, the retinal images are ill-defined, and hence can hardly stimulate the desire for fusion efficiently. If the power of convergence be great, a small error in measurement will seriously impair the accuracy of the result. The difference between 1 ma and 2 ma corresponds to a distance of 50 *cm*, but that between 10 ma and 11 ma is represented by a distance of less than 1 *cm*. Precise measurement is difficult, as the reckoning should be made from a point midway between the ocular centres.

In default of a better, I would tentatively suggest the following procedure; I cannot as yet speak very confidently about it, as I have not yet tested its accuracy in a sufficient number of cases. After the examination of the refraction and the accommodation of the eyes, glasses should be given, such that the near point of accommodation (pa) becomes $\frac{1}{3}$ *m*. The strongest adducting prisms compatible with single vision must now be found. The position of the near point of convergence (pc) can then be determined, either by the help of the tables or by means of a simple calculation.

For instance, a hypermetrope of + 7 D, with accommodation equal to + 4 D, will require a + 6 D lens to bring pa to $\frac{1}{3}$ *m*. Convex glasses of this strength must now be given, and accurately centred as if for distant vision. The power of convergence must now be tested, either by separating the lenses or by prisms. Suppose that in this case the limit of convergence is reached when each eye is furnished with a 14° d prism. On referring to Table II. it will be seen that an adducting prism of 47′, combined with a + 6 D lens, entails a convergence of 4 ma when the object of fixation is at $\frac{1}{3}$ *m*. Now the addition of a prism of 1° 42′ increases the convergence by 1 ma: a prism of 14° − 47′ must therefore

increase the convergence by $\frac{13^\circ\ 13'}{1^\circ\ 42'}$ ma, *i. e.*, 7.7 ma, if we assume that the angles are proportional to their tangents. Hence the total convergence is 4 + 7.7 ma, or 11.7 ma approximately.

Greater accuracy is obtained when the value of the prism is expressed in terms of decentration of the lens. The 14° d prism is equivalent to a decentration outwards in a + 6 D lens of 41.554 *mm* ($\frac{1000 \tan 14^\circ}{6}$ *mm*). On reference to Table II. it will be seen that a + 6 D lens must be decentred 17.4372 *mm* inward in order to annul convergence, and that 1 ma corresponds to a decentration of 4.933 *mm*. Hence the convergence is represented by $\frac{41.554 + 17.437}{4.933}$, or 11.958 ma. The near point of convergence is therefore 8.36 *cm*, corresponding to an angular deviation of 20° 56′.

It is only by precision in diagnosis and accuracy in the prescription of correcting glasses that satisfactory results can be obtained in the treatment of muscular asthenopia.

In order to avoid the want of definition due to the chromatic dispersion of strong prisms, I make this examination in the dark room, using monochromatic light to illuminate the object of fixation, *e. g.*, a spirit lamp which volatilizes some sodium carbonate.

In cases in which pa nearly coincides with pc (*e. g.*, myopia) Landolt's dynamometer gives accurate results and is very convenient.

Prisms are sometimes chosen at random, and ordered to be worn in the hope that they will relieve certain symptoms; it is not surprising that failure attends such unscientific treatment. Some discredit has fallen upon them, and many surgeons have abandoned their use, advocating operative procedures in their stead. It is with no intention of condemning such operations that I venture to offer a plea for a *fair* trial of prismospheres. The cure of muscular asthenopia, with all the varied and distressing symptoms it occasions in neurotic individuals, is as gratifying as it is difficult, but when the diagnosis is exact and the treatment scientific success is certain.

TABLE I.

			1 D	2 D	3 D	4 D	5 D	6 D	7 D	8 D	9 D	10 D	12 D	14 D	16 D	18 D	20 D
Convex.	Divergence decentration inwards. Convergence " outwards.	4 ma.	7°17′	124.5 7°6′	60.5 6°54′	39.1 6°42′	28.5 6°30′	22.1 6°18′	17.8 6°6′	14.7 5°54′	12.5 5°41′	10.7 5°30′	9.3 5°18′	7.1 4°54′	5.6 4°30′	4.5 4°6′	3.6 3°42′	2.9 3°18′
		3 ma.	5°29′	93.3 5°20′	45.3 5°11′	29.3 5°2′	21.3 4°53′	16.5 4°44′	13.3 4°35′	11.1 4°26′	9.3 4°17′	8.0 4°7′	6.9 3°59′	5.3 3°41′	4.2 3°23′	3.3 3°5′	2.7 2°47′	2.1 2°29′
		2 ma.	3°40′	62.2 3°33′	30.2 3°28′	19.6 3°21′	14.2 3°16′	11.0 3°9′	8.9 3°4′	7.4 2°57′	6.2 2°52′	5.3 3°45′	4.6 2°40′	3.6 2°27′	2.8 2°15′	2.2 2°3′	1.8 1°51′	1.4 1°39′
		1 ma.	1°50′	31.120 1°47′	15.121 1°44′	9.787 1°41′	7.121 1°38′	5.521 1°35′	4.454 1°32′	3.692 1°29′	3.121 1°26′	2.676 1°23′	2.321 1°20′	1.787 1°14′	1.406 1°8′	1.121 1°2′	.898 55′	.721 50′
			1° 0	16.975 58′	8.248 57′	5.339 55′	3.884 53′	3.011 52′	2.429 50′	2.014 48′	1.702 47′	1.460 45′	1.266 43′	.975 40′	.767 37′	.611 33′	.490 30′	.393 27′
Concave.	Convergence decentration inwards. Divergence " outwards.		1°	17.935 1°2′	9.207 1°3′	6.298 1°5′	4.843 1°6′	3.970 1°8′	3.389 1°10′	2.973 1°12′	2.661 1°13′	2.419 1°15′	2.225 1°16′	1.934 1°20′	1.726 1°23′	1.570 1°26′	1.449 1°30′	1.352 1°33′
		1 ma.	1°50′	32.879 1°53′	16.879 1°56′	11.546 1°59′	8.879 2°2′	7.279 2°5′	6.212 2°8′	5.450 2°11′	4.879 2°14′	4.435 2°17′	4.079 2°20′	3.546 2°26′	3.165 2°32′	2.879 2°38′	2.657 2°44′	2.479 2°50′
		2 ma.	3°40′	65.75 3°45′	33.7 3°52′	23.1 3°57′	17.7 4°4′	14.5 4°10′	12.4 4°15′	10.9 4°22′	9.7 4°28′	8.8 4°34′	8.1 4°40′	7.1 4°52′	6.3 5°4′	5.7 5°16′	5.3 5°28′	4.9 5°36′
		3 ma.	5°29′	98.6 5°38′	50.6 5°47′	34.6 5°56′	26.6 6°5′	21.8 6°14′	18.6 6°23′	16.3 6°32′	14.6 6°41′	13.3 6°50′	12.2 9°59′	10.6 7°16′	9.5 7°24′	8.6 7°42′	7.9 8°10′	7.4 8°27′
		4 ma.	7°17′	131.5 7°29′	67.5 7°41′	46.2 7°53′	35.5 8°5′	29.1 8°17′	24.8 8°29′	21.8 8°41′	19.5 8°52′	17.7 9°4′	16.3 9°16′	14.2 9°39′	12.6 10°3′	11.5 10°26′	10.6 10°50′	9.9 11°12′

The object of observation is presumed to be at a distance of more than 6 metres from the patient.
The figures in larger type indicate the amount of decentration in millimetres.
The figures in smaller type represent the deviating power of the prisms whose action is equivalent to that of the decentration of the lenses.

TABLE II.—(Convex.)

TABLE II.—(CONVEX.)

			1 D	2 D	3 D	4 D	5 D	6 D	7 D	8 D	9 D	10 D	12 D	14 D	16 D	18 D	20 D
DIVERGING.	4 ma.	7°17′	240.6 13°32′	118.5 13°20′	77.8 13°8′	57.5 12°57′	45.3 12°46′	37.2 12°34′	31.3 12°22′	27.0 12°11′	23.6 11°59′	20.9 11°48′	16.8 11°26′	13.9 11°2′	11.7 10°47′	10.0 10°21′	8.7 9°51′
	3 ma.	5°29′	206.6 11°40′	101.9 11°31′	67.1 11°23′	49.7 11°14′	39.2 11°6′	32.2 10°57′	27.2 10°48′	23.5 10°39′	20.6 10°31′	18.3 10°22′	14.8 10°4′	12.3 9°47′	10.4 9°29′	8.9 9°11′	7.8 8°54′
	2 ma.	3°40′	172.6 9°47′	85.4 9°42′	56.3 9°36′	41.8 9°30′	33.1 9°24′	27.3 9°18′	23.1 9°12′	20.0 9°7′	17.6 9°1′	15.7 8°55′	12.8 8°43′	10.7 8°31′	9.1 8°17′	7.9 8°7′	6.9 7°56′
	1 ma.	1°50′	138·6 7°53′	68.8 7°50′	45.6 7°48′	34.0 7°45′	27.0 7°42′	22.3 7°39′	19.0 7°36′	16.5 7°33′	14.6 7°30′	13.1 7°27′	10.7 7°21′	9.1 7°15′	7.8 7°9′	6.8 7°3′	6.1 6°57′
		0	104.6236	52.3118	34.8745	26.1559	20.9247	17.4372	14.9462	13.0779	11.6248	10.4623	8.7186	7.4731	6.5389	5.8124	5.2312
CONVERGING.			5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58″	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′
	1 ma.	1°50′	70.6 4°2′	35.7 4°5′	24.1 4°8′	18.3 4°11′	14.8 4°14′	12.5 4°18′	10.8 4°21′	9.6 4°23′	8.6 4°26′	7.8 4°29′	6.7 4°36′	5.8 4°41′	5.2 4°47′	4.7 4°53′	4 3 4°59′
	2 ma.	3°40′	36.6 2°6′	19.2 2°12′	13.4 2°18′	10.5 2°24′	8.7 2°30′	7.6 2°36′	6.7 2°42′	6.1 2°48′	5.6 2°54′	5.2 3°	4.6 3°12′	4.2 3°24′	3.9 3°36′	3.7 3°48′	3.5 4°
	3 ma.	5°29′	2.6 9′	2.6 18′	2.6 27′	2.6 36′	2.6 45′	2.6 54′	2.6 1°3′	2.6 1°13′	2.6 1°22′	2.6 1°31′	2.6 1°49′	2.6 2°7′	2.6 2°25′	2.6 2°43′	2.6 3°1′
	4 ma.	7°17′	−31.3 (1°48′)	−13.9 (1°36′)	−8.1 (1°24′)	−5.2 (1°12′)	−3.4 (59′)	−2.3 (47′)	−1.4 (35′)	−.84 (23′)	−.36 (11′)	.03 1′	.61 25′	1.02 49′	1.3 1°13′	1.58 1°37′	1.77 2°2′
Difference for 1 ma.			33.995 1°57′	16.558 1°54′	10.743 1°51′	7.839 1°48′	6.0957 1°45′	4.933 1°42′	4.1029 1°39′	3.4801 1°36′	2.9957 1°33′	2.6082 1°30′	2.0270 1°24′	1.6119 1°18′	1.3004 1°12′	1.0582 1°6′	.8645 59′
Difference for 1°			18.54 1°3′	9.032 1°2′	5.861 1°	4.276 59′	3.325 57′	2.691 55′	2.2380 53′	1.8983 52′	1.6341 50′	1.4227 49′	1.1057 46′	.8792 42′	.7093 39′	.5772 36′	.4716 32′

The object of observation is presented to be ⅓ metre from the centre of rotation of the globe.
The figures in larger type give the amount of decentration in millimetres.
—ve sign indicates decentration outwards ; +ve sign decentration inwards.
The figures in smaller type represent the deviating power of the prisms whose action is equivalent to that of the decentration of the lenses. When enclosed in brackets the prisms are adducting in junction, and should be placed edges inwards.

TABLE III.—(Concave.)

			−1 D	−2 D	−3 D	−4 D	−5 D	−6 D	−7 D	−8 D	−9 D	10 D	−12 D	−14 D	−16 D	−18 D	−20 D
Diverging.	4 ma.	7°17′	−247.6 13°55′	−125.6 14°6′	−84.9 14°17′	−64.5 14°28′	−52.3 14°40′	−44.2 14°51′	−38.4 15°2′	−34.0 15°14′	−30.6 15°25′	−27.9 15°36′	−23.8 15°59′	−20.9 16°21′	−18.8 16°43′	−17.1 17°5′	−15.7 17°27′
	3 ma.	5°29′	−211.9 11°58′	−107.2 12°7′	−72.4 12°15′	−54.9 12°24′	−44.5 12°32′	−37.5 12°41′	−32.5 12°49′	−28.8 12°58′	−25.9 13°7′	−23.5 13°16′	−20.1 13°33′	−17.6 13°50′	−15.7 14°7′	−14.3 14°24′	−13.1 14°41′
	2 ma.	3°40′	−176.1 9°59′	−88.9 10°5′	−59.9 10°11′	−45.3 10°17′	−36.6 10°23′	−30.8 10°29′	−26.6 10°35′	−23.5 10°40′	−21.1 10°46′	−19.2 10°52′	−16.3 11°4′	−14.2 11°15′	−12.6 11°27′	−11.4 11°39′	−10.5 11°50′
	1 ma.	1°50′	−140.4 7°59′	−70.6 8°2′	−47.4 8°5′	−35.7 8°8′	−28.8 8°11′	−24.1 8°14′	−20.8 8°17′	−18.3 8°20′	−16.4 8°23′	−14.8 8°26′	−12.5 8°32′	−10.8 8°38′	−9.6 8°44′	−8.6 8°50′	−7.8 8°56′
		0	−104.6236	−52.3118	−34.8745	−26.1559	−20.9247	−17.4372	−14.9462	−13.0779	−11.6248	−10.4623	−8.7186	−7.4731	−6.539	−5.8124	−5.2312
			5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′	5°58′
Converging.	1 ma.	1°50′	−68.9 3°56′	−34.0 3°53	−22.4 3°50′	−16.5 3°47′	−13.1 3°44′	−10.7 3°41′	−9.1 3°38′	−7.8 3°35′	−6.9 3°32′	−6.1 3°29′	−4.9 3°23′	−4.1 3°17′	−3.5 3°11′	−3.0 3°5′	−2.6 2°59′
	2 ma.	3°40′	−33.1 1°54′	−15.7 1°48′	−9.8 1°42′	−6.9 1°36′	−5.2 1°30′	−4.0 1°24	−3.2 1°18′	−2.6 1°12′	−2.1 1°5′	−1.7 59′	−1.1 47′	−.73 35′	−.42 23′	−.18 11′	.01 (1′)
	3 ma.	5°29′	2.6 (9′)	2.6 (18′)	2.6 (27′)	−2.6 (36′)	2.6 (45′)	2.6 (54′)	2.6 (1°3′)	2.6 (1°12′)	2.6 (1°21′)	2.6 (1°31′)	2.6 (1°49′)	2.6 (2°7′)	2.6 (2°25′)	2.6 (2°43′)	2.6 (3°1′)
	4 ma.	7°17′	38.4 (2°12′)	20.9 (2°24′)	15.1 (2°36′)	12.2 (2°48)	10.5 (3°)	9.3 (3°12′)	8.5 (3°24′)	7.9 (3°36′)	7.4 (3°48′)	7.0 (4°)	6.4 (4°24′)	6.0 (4°48′)	5.7 (5°12′)	5.4 (5°36′)	5.2 (6°)
Difference for 1 ma.			35.754 2°3′	18.316 2°6′	12.504 2°9′	9.598 2°12′	7.854 2°15′	6.6916 2°18′	5.8613 2°21′	5.2385 2°24′	4.7541 2°27′	4.3667 2°30′	3.7854 2°36′	3.3702 2°42′	3.0588 2°48′	2.8167 2°54′	2.6229 3°
Difference for 1°			19.502 1°7′	10.088 1°9′	6.820 1°10′	5.235 1°12′	4.284 1°14′	3.650 1°15′	3.1971 1°17′	2.8574 1°18′	2.5932 1°20′	2.3819 1°22′	2.0648 1°25′	1.8383 1°28′	1.6685 1°32′	1.5364 1°35′	1.4307 1°38′

The object of observation is presumed to be $\frac{1}{4}$ metre from the centre of rotation of the globe.
The figures in larger type give the amount of decentration in millimetres.
$-^{ve}$ sign indicates decentration outwards; $+^{ve}$ sign decentration inwards.
The figures in smaller type represent the deviating power of the prisms whose action is equivalent to that of the decentration of the lenses. When enclosed in brackets the prisms are adducting in junction, and should be placed edges inwards.

THE RESULTS OF THE VARIOUS METHODS OF EXTRACTION OF CATARACT, ILLUSTRATED BY TWO HUNDRED AND SIX CASES.

By D. B. St. JOHN ROOSA, M.D., LL.D.

IT is quite possible, that the value of statistics of the operation for extraction of cataract has very much diminished of late years, since the publication of voluminous and interesting tables illustrating this subject; but I have thought that there would be a certain interest in an additional paper on the extraction of the cataractous lens, if it gave, as will the one that I have the honor to present, the statistics of one operator in a series of cases, many of which were observed for several years. I have hitherto refrained from any such publication, for the reason that I have not believed that what I had to say, was of sufficient importance to break in on the line of valuable contributions that have been made by many authorities in ophthalmic practice.

Now, however, that we know from thousands of reported cases, about what percentage in the hands of an average operator will result in useful vision, I believe even the report of a moderate number of consecutive cases, operated upon by different methods, yet by one operator, and followed up, in many instances, by years of observation, will have a certain interest, entitling it to be presented to my brother ophthalmologists. My paper will thus exhibit some of the vicissitudes of patients who have been operated upon for cataract. The cases are in no sense selected ones, for I have omitted none of which I have any adequate memoranda, and I have been in the habit of rejecting no cases as unfit for

operation in which there was any chance of a good result. Connected, since its organization, with the Manhattan Eye and Ear Hospital, where Agnew, *facile princeps* as an operator, gave so many years of faithful and brilliant service, it is not to be wondered at, that, in common with his other colleagues in this institution, I have been glad to take the cases that did not demand him.

The report embraces all the cases that I have ever operated upon by extraction, with the exception of an uncertain number, probably twenty in all, operated upon at Burlington, Vermont, in the clinic of the university of that State, whose records have been destroyed or lost. The cases comprise such as I have operated upon at the Manhattan Eye and Ear Hospital, in the Burlington clinic just alluded to, and in my private practice.

I have now been operating for cataract since 1865. It will be seen that I began when Beer's knife was almost universally employed, and the ordinary flap without an iridectomy was made. I was taught the old-flap extraction at the hands of Schuft-Waldau, and Graefe, in Berlin, and Arlt, in Vienna. Since then have come Graefe's knife, and his operation with an iridectomy, Liebreich's operation and its imitations, the operations for the removal of the lens in its capsule, and finally the return to the simple flap operation with Graefe's knife and without an iridectomy.

It is true that many operators, especially in England, adhere to the concurrent iridectomy, but the general consensus seems to be in favor of what is termed simple extraction. My cases illustrate in a minor way, all these phases of changes in the professional mind upon this important subject.

They may have a little interest from that standpoint. Be that as it may, they certainly will be entitled to a slight consideration, at least, because they represent the experience of one operator through two decades of professional work. As I have already said, I have had the rare opportunity of observing some of these cases for years, and consequently of noting what is very little written about, so far as I have seen—the changes which occur to the eye without a lens.

They illustrate something also (especially in two families in each of which I have performed three operations)—what heredity may have to do with the formation of cataract.

The greatest change that has come upon this important operation, is the use of Koller's discovery of the anæsthetic property of cocaine. This may be said to have deprived the operation of extraction of nearly all its horrors, because we were always between Scylla and Charybdis before we had cocaine. There was the restlessness and the pain suffered by the patient, the liability to uncontrollable movement of the eye, if one operated without an anæsthetic, and the occasional deplorable consequences of the anæsthetic upon the healing, or the beginning of the healing, of the wound. Certainly one of the failures here reported may be ascribed to the struggling during incomplete anæsthesis, induced by the use of ether, although in the hands of an experienced person. And yet, in another case, nervous agitation produced by the operation without an anæsthetic caused such a shaking of the head immediately after it was finished, although the patient had nerved herself to its performance, as to cause entire loss of the eye. The earlier ones are those of an inexperienced operator, the later ones were performed when more skill in the technique and more judgment had been acquired by the years of practice.

I have never become a convert to the active local antiseptic measures that have been practised in many of the clinics, and which have had some advocates so earnest that they have almost denounced those as guilty of malpractice who failed to comply with the latest antiseptic precautions, as laid down by the latest writer on this subject. I do not underrate in any manner the magnitude of Lister's great work, the importance of the subject of absolute cleanliness, on which after all the whole thing turns, and I have become more and more careful as to the cleansing of the eye from all external irritants, the previous treatment of any conjunctival or lachrymal catarrh, the cleansing of the instruments, of the hands of the operator and those of his assistants; but I do not use carbolic acid or bichloride, or any of the special

antiseptic fluids, but simply a boracic acid solution for cleansing the eye, hot water and soap for the instruments, dipping them in boiling hot water just before using, and zealously looking after the forceps with a magnifying glass. Some of the antiseptic enthusiasts, seem to me to have utterly ignored the mechanical and chemical conditions, which may produce want of coaptation of a corneal flap, and consequently imperfect healing. That suppuration may result from the forcible opening of the wound, when every precaution has been taken as to cleanliness, cannot be denied; or that a constant agitation of the flaps, such as occurred in the case where the patient, an old lady, shook her head continuously for twenty-four hours, beginning immediately after the operation was performed, may do the same thing.

I have pursued various methods as to the after-treatment, but I have finally come down to leave the eye closed under the bandages for at least four or five days, whenever possible. I have never forsaken Graefe's bandage, except a very short period, when I used a black patch. I believe that better adapted than anything else for keeping the eye quiet, and that it is generally comfortable to the patient, and a great preventive of injury to the eyeball.

As the years have gone on, I have changed very much my ideas of the necessity of keeping the room free from light or of preventing the patient from moving or sitting up in bed. I allow much more latitude in that direction. I am inclined, however, to operate upon restless patients on the bed where the patient is afterward to lie.

I know of a very competent operator in Louisville, Kentucky, who allows some of his patients to go home twenty miles or more in a country wagon, and although I have had at least three successful cases that have undergone at least this much, I do not advise anything but a quiet recumbent position during the first few hours after an extraction of cataract by the flap method.

After inventing a method for the extraction of the lens in its capsule, which I practised almost exclusively for a year or so, I gave it up because it seemed to me, that its great supposed advantage did not exist, and because it is an

operation much more difficult than what I now usually perform—simple extraction.[1]

Cocaine has but once failed me as an efficient local anæsthetic, and that was in an operation performed on March 2d of this year, and not included in this paper. This was in the case of an unruly and stupid old woman, for whom I performed a preliminary iridectomy with great difficulty, although her eye was fully anæsthetized. The house surgeon of the hospital, Dr. Black, for two weeks drilled her in the technique of bearing the operation, but all without avail. Ether was then given, and although with great care, she became asphyxiated and the radial pulse stopped, so that I was obliged to give up the ether, to give a dose of whiskey, use cocaine, and operate an hour later. The section was made with a moderate degree of difficulty, and just as I was beginning to congratulate myself she pushed out the lens and a small quantity of vitreous with her orbicularis. She has done well and has good vision, although she had delirium. Before presenting the general table I wish to add, that the statistics of but 204 are tabulated, because the 205th and 206th cases were not operated upon with any hope of restoring sight: one was for cosmetic reasons; the other, that of a poor young woman from the Blind Asylum with an atrophy of the optic nerve, certainly in one eye and probably in the other, at her urgent request.

[1] In this operation I dislocated the lens with the back of the knife before finishing the section.

TABLE OF THE RESULTS OF THE EXTRACTION OF CATARACT IN 206 EYES.[1]

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
1	M. 55.	L.	Ether. Flap. Beer's knife. Iris wounded. 39 days.	Iridectomy.	V=$\frac{20}{200}$. Later, V=$\frac{20}{100}$.
2	M. 55. Same as No. 1.	R.	Ether. Flap. Beer's knife. 15 days.	Keratonyxis.	V=$\frac{20}{100}$.
3	M. 45.	L.	Lower section. Beer's knife. 20 days.	None.	V=$\frac{20}{100}$.
4	F. 60.	L.	Flap. Beer's knife. 18 days.	None.	V=$\frac{20}{70}$.
5	F. 70.	R.	Flap. Beer's knife. 28 days.	None.	V=$\frac{20}{200}$.
6	F. 50.	L.	Ether. After preliminary iridectomy. 25 days.	Iridectomy.	V=$\frac{12}{200}$.
7	M. 56.	R.	Lower section. Beer's knife. Iridectomy. 50 days.	None.	V=$\frac{20}{200}$.
8	M. 65.	L.	Ether. Lower flap. Beer's knife. 28 days.	None.	V=$\frac{20}{200}$.
9	M. 56. Same as No. 7.	L.	Ether. Lower section. Beer's knife. 21 days.	None.	V=$\frac{20}{70}$.
10	M. 30.	L.	Ether. Linear. 40 days.	Keratonyxis 3 times.	V=$\frac{20}{70}$.
11	F. 60.	L.	Flap. with iridectomy. Beer's knife. 26 days.	Keratonyxis.	V=$\frac{20}{100}$.
12	F. 66.	R.	Liebreich. 45 days.	Keratonyxis.	V=$\frac{20}{100}$.
[2]13	F. 60. Same as No. 11.	R.	Liebreich. Lens dislocated into vitreous. Wound reopened one week later and lens removed. 49 days.	Keratonyxis.	V=$\frac{20}{200}$. Later, V=$\frac{20}{70}$.
14	F. 67.	L.	Ether. Simple. 25 days.	Keratonyxis.	V=$\frac{20}{50}$.
15	M. 57. Paralysis agitans.	L.[2]	Liebreich. Iris wounded. Loss of vitreous. 90 days.	Keratonyxis 3 times.	V=$\frac{12}{200}$.
16	F. 57.	R.	Ether. Graefe. Iris wounded. 89 days.	Iridotomy.	V=$\frac{10}{200}$.
17	F. 53.	R.	Graefe. 23 days.	None.	V=$\frac{20}{70}$.
18	M. 67.	R.	Ether. Liebreich.		V=$\frac{20}{100}$.
19	F. 20.	R.	Ether. Graefe. Loss of vitreous. Globe collapsed.	None.	V=Counts fingers.
20	F. 75.	L.	Graefe. Loss of vitreous. 22 days.	None.	V=$\frac{14}{200}$.
21	F. 49.	L.	Ether. Section downward. Iridectomy. 20 days.	Keratonyxis.	V=$\frac{20}{100}$.
22	M. 75.	R.	Ether. Section downward. Iridectomy. Iris wounded. 20 days.	None.	V=$\frac{20}{100}$.
23	M. 59.	L.	Ether. Graefe.	None.	V=0. Keratoirido-choroiditis.
24	F. 55.	R.	Graefe. Loss of vitreous. 33 days.	None.	V=Perception of light.
25	M. 75.	R.	Ether. Graefe. 35 days.	Declined.	V=Perception of light.

[1] For much valuable and indispensable assistance in preparing these tables, I am glad to thank my chief of staff, Dr. Frank N. Lewis, Assistant-Surgeon in the Manhattan Eye and Ear Hospital.

[2] Transactions Am. Ophth. Society, 1873, page 69.

No.	Sex. Age. Heaith.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
26	M. 75. Same as No. 25.	L.	Ether. Graefe. 16 days.	None.	V=Perception of light.
27	F. 72.	L.	Ether. Graefe. 40 days.	None.	V=$\frac{20}{40}$.
28	M. 44.	R.	Ether. Graefe. 13 days.	None.	V=Counts fingers.
29	F. 50.	L.	Ether. Graefe. Iris wounded. 22 days.	None.	V=$\frac{20}{70}$.
30	M. 61.	R.	Lens in capsule. Loss of vitreous. 22 days.	None.	V=$\frac{20}{200}$.
31	F. 73.	L.	Ether. Graefe. Loss of vitreous. 31 days.	None.	V=Counts fingers.
32	M. 28.	R.	Ether. Graefe. 30 days.	Keratonyxis and iridotomy.	V=$\frac{20}{100}$.
33	F. 52.	R.	Ether. Graefe. 30 days.	None.	V=$\frac{20}{70}$.
34	M. 28. Same as No. 32.	L.	Ether. Lower section. Iridectomy. 15 days.	None.	V=$\frac{20}{100}$.
35	F. 28.	R.	Ether. Graefe. Iris wounded. 22 days.	None.	V=$\frac{20}{100}$.
36	M. 45.	L.	Ether. Lower section. Iris wounded. Iridectomy. 29 days.	None.	V=$\frac{20}{50}$.
37	F. 50.	L.	Ether. Lower section. Iris wounded. Iridectomy. 13 days.	None.	V=$\frac{20}{200}$.
38	M. 44.	R.	Ether. Graefe. Iris wounded. Loss of vitreous. 8 days.	None.	V=Perception of light.
39	F. 74.	L.	Ether. Graefe. Loss of fluid vitreous. 41 days.	Iridectomy.	V=Large objects.
40	F. 70.	R. Myopic.	Ether. Graefe. 40 days.	None.	V=$\frac{20}{100}$.
41	F. 70.	L.	Ether. Lower section. Iridectomy. 24 days.	None.	V=$\frac{20}{100}$.
42	F. 63.	R.	Ether. Graefe. 25 days.	Keratonxyis.	V=$\frac{20}{200}$.
43	M. 76.	R.	Ether. Lens in capsule. Loss of vitreous. 32 days.	None.	V=$\frac{20}{70}$.
44	M. 69. Good.	L. Senile. 1½ yrs.	Ether. Graefe. Loss of vitreous. Very unruly; sent home. 1 day.	None.	V=$\frac{20}{100}$.
45	F. 60. Good.	R. Inflammatory. V. F. imperfect.	Preliminary iridectomy 6 months before. 60 days.	None.	V=Perception of light.
46	M. 70. Good.	R. Senile.	Ether. Lens in capsule. 18 days.	None.	V=$\frac{20}{70}$.
47	M. 66. Good.	R. Senile.	Lens in capsule. Small iridectomy. 18 days.	None.	V=$\frac{20}{40}$.
48	M. 52. Alcoholic.	R. Senile. 2 yrs.	Ether. Lens in capsule. Iris wounded. Small iridectomy. Loss of vitreous. 14 days.	None.	V=$\frac{18}{200}$.
49	F. 58. Good.	L. Senile. 6 yrs.	Ether. Section downward. No iridectomy. 12 days.	None.	V=$\frac{8}{200}$.
50	F. 44. Good.	R. Senile. 9 yrs.	Ether. Lens in capsule. Loss of vitreous. 41 days.	None.	V=$\frac{20}{70}$. 6 mos. later, V=$\frac{20}{100}$.
51	F. 53. Good.	L. Senile. Corneal opacities.	Ether. Preliminary iridectomy. 15 days.		V=$\frac{15}{200}$.
52	M. 60. Poor.	R. Glaucomatous. 11 days. V. F. bad.	Ether. Iridectomy for glaucoma 11 days before.	None.	V=Perception of light.
53	F. 65. Good.	L. Senile.	Ether. Section downward. 36 days.	Keratonyxis.	V=$\frac{20}{100}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
54	F. 53. Good.	R. Senile. 8 yrs.	Ether. Preliminary iridectomy 6 months before. Lens in capsule. Loss of vitreous. 144 days.	None.	V=$\frac{1}{200}$. Iridochoroiditis.
55	M. 56. Good.	L. Senile. 1 yr.	Ether. Preliminary iridectomy. 27 days.	None.	V=$\frac{20}{100}$. 1 year later, V=$\frac{10}{200}$.
56	F. 77. Good.	R. Senile. 5 yrs.	Ether. Lens in capsule. 42 days.	None.	V=$\frac{8}{200}$.
57	F. 65. Good.	L. Senile. 4 yrs.	Cocaine. Preliminary iridectomy. Section downward. 30 days.	None.	V=$\frac{20}{200}$.
58	M. 61. Good.	L. Senile.	Cocaine. Lens in capsule. Section downward. 16 days.	None.	V=$\frac{20}{40}$.
59	F. 61. Good.	L. Senile. 3 yrs.	Cocaine. Preliminary iridectomy. Lens in capsule. Loss of vitreous. 22 days.	None.	V=$\frac{20}{100}$.
60	M. 72. Good.	R. Senile. 5 yrs. Perception poor.	Cocaine. Lens in capsule. Loss of vitreous. 23 days.	None.	V=No perception.
61	F. 50. Good.	L. Senile.	Cocaine. Lens in capsule. Loss of vitreous. 27 days.	None.	V=$\frac{20}{40}$.
62	F. 58. Good.	L. Inflammatory. 2 yrs. Posterior-synechia.	Cocaine. Preliminary iridectomy. 68 days.	Iridotomy.	V=$\frac{8}{200}$.
63	F. 58. Good.	R. Inflammatory. 2 yrs. Post.-synech.	Cocaine. Preliminary iridectomy. Part of lens removed. Loss of vitreous.		Enucleation.
64	F. 70. Good.	L. Senile. 5 mos.	Cocaine. Lens in capsule. Loss of vitreous. 57 days.	None.	V=$\frac{20}{200}$.
65	F. 50. Good.	R. Senile. 3 mos.	Cocaine. Lens in capsule. Eversion of flap. Loss of vitreous. 37 days.	None.	V=$\frac{20}{200}$.
66	F. 64. Good.	L. Senile. 3 mos.	Cocaine. Preliminary iridectomy. Lens removed by spoon. 34 days.	Iridectomy.	V=Perception of light.
67	F. 63. Good.	L. Senile. 2 yrs.	Cocaine. Lens in capsule. Iridectomy. Loss of vitreous. 52 days. 2 months later, hypopyon-iritis; pus absorbed by use of hot water. V remained $\frac{20}{70}$.	None.	V=$\frac{20}{70}$. Feb., 1890, V=$\frac{20}{70}$.
68	M. 64. Good.	L. Senile. 2 yrs.	Cocaine. Preliminary iridectomy. Lens in capsule. 33 days.	Keratonyxis.	V=$\frac{20}{70}$.
69	M. 58. Good. Same as No. 55.	R. Senile. 3 yrs.	Cocaine and ether. Liebreich. 28 days.	Keratonyxis.	V=$\frac{20}{200}$.
70	F. 54. Good.	L. Senile. Chronic conjunctivitis.	Ether. Lens in capsule. Section downward. Loss of vitreous. 24 days.		V=$\frac{20}{100}$.
71	M. 62. Good.	R. Senile. 2 yrs.	Cocaine. Lens in capsule. Loss of vitreous. 16 days.	None.	V=$\frac{20}{200}$.
72	M. 55. Good.	R. Senile. 1 yr.	Cocaine. Preliminary iridectomy 5 days before. 64 days. Hypopyon-iritis.	Paracentesis.	V=Perception of light.
73	M. 53. Good.	L. Senile. 6 yrs. V.F. imperfect	Cocaine. Lens in capsule. Loss of vitreous. 54 days.	None.	V=$\frac{20}{200}$.
74	M. 55. Same as No. 72.	L. Senile. 1 yr.	Cocaine. Lens in capsule. Iris wounded. 29 days.	None.	V=$\frac{20}{40}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
75	F. 64. Good.	L. Senile. 5 yrs.	Cocaine. Lens in capsule. Iris wounded. Loss of vitreous. Later flap found dislocated. 74 days.	None.	V=Counts fingers.
76	M. 55. Good.	L. Senile.	Cocaine. Preliminary iridectomy. Loss of vitreous before section completed. Lens dislocated into vitreous. 27 days.	None.	V=$\frac{1}{200}$.
77	M. 59. Good.	L. Senile. 6 mos.	Cocaine. Section downward. Capsule ruptured by knife. Iris wounded. 22 days.	Keratonyxis.	V=$\frac{20}{70}$. 4 mos. later, keratonyxis. V=$\frac{20}{100}$.
78	F. 75. Good.	R. Senile.	Cocaine. Lens in capsule. Iridectomy. Loss of vitreous. Eversion of flap. 44 days.	Keratonyxis.	V=$\frac{20}{200}$ 2 mos. later, V=$\frac{20}{200}$.
79	F. 62. Good.	L. Senile. Chr. glaucoma.	Ether. Preliminary iridectomy. 57 days.	Keratonyxis.	V=$\frac{20}{200}$. 4 yrs. later, V=$\frac{20}{200}$.
80	F. 52. Good.	L. Senile. Retino-choroiditis.	Ether. Preliminary iridectomy 9 days before. Lens in capsule. 22 days.	None.	V=$\frac{20}{100}$.
81	M. 74. Good.	R. Senile. 6 yrs.	Cocaine. Lens in capsule. 15 days.	None.	V=$\frac{20}{80}$. 2 years later, V=$\frac{20}{40}$.
82	F. 60. Good.	L. Senile. 2 yrs.	Cocaine. Lens in capsule. Iridectomy by knife. 23 days.	None.	V=$\frac{20}{80}$.
83	M. 59.	L. Senile.	Cocaine. Lens in capsule. Iris wounded. Cornea collapsed. 35 days.	None.	V=$\frac{20}{200}$. 4 years later, V=Perception of light.
84	F. 67. Good.	R. Senile. 3 yrs.	Cocaine. Lens in capsule. Section downward. 22 days.	None.	V=$\frac{20}{200}$. 1 year later, V=$\frac{20}{40}$.
85	F. 63. Good.	L. Senile. 6 yrs.	Cocaine. Simple. Iris wounded. 44 days.	Iridectomy.	V=$\frac{20}{40}$.
86	M. Good.	R. Senile. Choroiditis.	Cocaine. Lens in capsule. Iris wounded. 17 days.	None.	V=$\frac{20}{100}$.
87	M. 65. Fair.	L. Senile.	Cocaine. Lens in capsule. Iris wounded. Vitreous lost. Died 38 days later.	None.	V=$\frac{20}{100}$, estimated.
88	M. 58. Good.	L. Senile.	Cocaine. Simple. 37 days.	Keratonyxis.	V=$\frac{20}{40}$.
89	F. 53. Good.	L. Senile. 5 yrs. Chr. conj.	Cocaine. Förster 1 year before. 32 days.	Keratonyxis.	V=$\frac{20}{40}$.
90	M. 69. Good.	R. Senile. 2 yrs.	Cocaine. Simple. Piece of iris excised. 29 days.	Keratonyxis.	V=$\frac{20}{60}$.
91	M. 64. Good.	L. Senile. 3 yrs.	Cocaine. Simple. 42 days.	Keratonyxis.	V=$\frac{20}{200}$. 2 yrs. later, V=$\frac{20}{100}$.
92	F. 56. Good.	L. Senile. 3 mos.	Cocaine. Simple. 23 days.	None.	V=$\frac{20}{40}$.
93	F. 60. Fair.	R. Senile. Chr. conj.	Cocaine. Preliminary iridectomy. 42 days.	Keratonyxis.	V=$\frac{20}{60}$. 2½ yrs. later, V=$\frac{20}{60}$.
94	M. 70. Good.	L. Senile. 6 mos.	Cocaine. Simple. 31 days.	None.	V=$\frac{20}{200}$. 1 yr. later, V=$\frac{20}{60}$.
95	F. 79. Fair.	L. Senile. 5 yrs.	Cocaine. Simple. 43 days.	None.	Panophthalmitis, following suppuration of flap.
96	F. 46. Good.	L. Senile. 5 yrs.	Cocaine. Simple. 22 days.	None.	V=$\frac{20}{80}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
97	F. 70. Fair.	R. Senile. 2 yrs.	Cocaine. Lens in capsule. 15 days.	None.	V=$\frac{20}{40}$.
98	F. 70. Fair.	R. Senile. 3 yrs.	Cocaine. Simple. Patient unruly. 17 days.	None.	V=$\frac{20}{100}$.
99	F. 74. Fair.	R. Senile. 3 yrs.	Cocaine. Lens in capsule. Vitreous lost. 26 days.	None.	Suppuration of cornea senile. Dementia. Died.
100	M. 63. Alcoholic.	R. Senile. 6 mos.	Cocaine. Lens in capsule. Vitreous lost. 32 days.	None.	V=$\frac{20}{40}$. 2 years later, V=$\frac{20}{40}$.
101	M. 75. Good.	L. Senile.	Cocaine. Simple. Downward. 77 days.	Iridotomy.	V=Perception of light. Suppuration corneal edge.
102	F. 67. Poor.	L. Senile.	Cocaine. Graefe. Vitreous lost. Collapse of cornea. 46 days.	Keratonyxis.	V=$\frac{20}{100}$, later V=$\frac{20}{200}$.
103	M. 63. Good.	L. Senile.	Cocaine. Simple. 63 days.	Keratonyxis.	V=$\frac{7}{200}$. Suppuration of wound.
104	M. 30. Brother of No. 32.	R. Congenital.	Cocaine. Preliminary iridectomy. 21 days.	Keratonyxis.	V=$\frac{20}{100}$.
105	M. 68. Good.	L. Senile. 2 yrs.	Cocaine. Simple. 46 days.	None.	V=$\frac{20}{100}$.
106	M. 67. Good.	R. Senile. 1½ yrs.	Cocaine. Simple. 14 days.	None.	V=$\frac{20}{60}$.
107	F. 50. Good.	L. Senile. 7 mos.	Cocaine. Simple. 19 days.	None.	V=$\frac{20}{200}$.
108	M. 62. Good.	R. Senile. 8 mos.	Cocaine. Simple. 31 days.	Keratonyxis.	V=$\frac{3}{100}$. Kerato-iritis.
109	F. 60. Good.	R. Senile.	Cocaine. Simple. 38 days.	Iridotomy.	V=Counts fingers. 6 mos. later, V=$\frac{10}{200}$.
110	M. 80. Good.	R. Senile. 2 yrs.	Cocaine. Simple. 31 days.	Iridotomy.	V=Counts fingers. Keratoiritis.
111	F. 50. Good.	L. Senile. 4 yrs. V.F. imperfect	Cocaine. Graefe. 29 days.	None.	V=$\frac{7}{200}$.
112	M. 48. Fair.	L. Senile. 4 yrs. Projection slow.	Cocaine. Graefe. 36 days.	Keratonyxis.	V=Perception of light.
113	M. 65. Good.	L. Senile. 6 mos.	Cocaine. Graefe. 27 days.	None.	Phthisis bulbi. Enucleation.
114	F. 64. Fair.	R. Senile. 2½ yrs.	Cocaine. Graefe. Unruly; removed bandage herself. 28 days.	None.	V=$\frac{20}{40}$.
115	F. 70. Good.	R. Senile. 5 yrs.	Cocaine. Preliminary iridectomy. 21 days.	Keratonyxis.	V=Perception of light. Hypopyon - iritis.
116	F. 53. Good.	R. Senile. 3 yrs.	Cocaine. Graefe. Vitreous lost. 41 days.	None.	Phthisis bulbi.
117	F. 70. Good.	L. Senile. 3½ yrs.	Cocaine. Graefe. 21 days.	None.	V=$\frac{20}{100}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
118	F. 50. Good.	R. Senile. 2 yrs. Eye always amblyopic.	Cocaine. Graefe. Vitreous lost. 39 days.	Keratonyxis.	V=$\frac{3}{200}$. Detachment of retina 9 mos. later.
119	F. 28. Good.	R. Congenital Small cornea	Cocaine. Preliminary iridectomy. 9 days.	Keratonyxis.	V=$\frac{6}{200}$. Later, V=$\frac{15}{200}$.
120	F. 66. Fair.	R. Senile. 2 yrs.	Cocaine. Graefe. 14 days.	None.	V=$\frac{20}{50}$.
121	M. 48. Good.	L. Senile. Dacrocystitis.	Cocaine. Preliminary iridectomy. 21 days.	None.	V=$\frac{20}{70}$.
122	M. 49. Poor.	L. Senile. Hypermature.	Cocaine. Graefe. 46 days.	None.	V=$\frac{15}{200}$.
123	F. 28. Same as No. 119.	L. Congenital Small cornea	Ether. Linear. 10 days.	None.	V=$\frac{20}{200}$.
124	M. 65. Same as No. 113.	R. Senile. Inflammatory. V F. poor.	Ether. Preliminary iridectomy. 18 days.	None.	V=Perception of light.
125	M. 62. Same as No. 83.	R. Senile. 3 yrs.	Cocaine. Preliminary iridectomy. 45 days.	None.	V=$\frac{3}{200}$.
126	M. 13. Good.	R. Traumatic. 6 mos.	Cocaine. Linear. 19 days.	Iridotomy.	V=$\frac{20}{100}$.
127	F. 50. Same as No. 118.	L. Senile. Myopic. Not mature.	Cocaine. Simple. Vitreous lost. 44 days.	Iridotomy.	V=$\frac{9}{200}$ without a glass.
128	M. 73. Good.	R. Senile. 8 yrs.	Cocaine. Lens in capsule unintentional. 26 days.	None.	V=$\frac{20}{200}$.
129	M. 69. Same as No. 68.	R. Senile. 8 yrs.	Cocaine. Simple. 14 days.	None.	V=$\frac{20}{40}$. Later, V=$\frac{20}{30}$.
130	M. 32. Same as No. 104.	L. Congenital	Cocaine. Preliminary iridectomy. 17 days.	None.	V=$\frac{7}{200}$. Later, V=$\frac{20}{40}$.
131	F.	L. Capsular.	Cocaine. Simple. 24 days.	None.	V=$\frac{20}{200}$.
132	F. 60. Fair.	L. Senile.	Ether. Lens in capsule. 18 days.	Iridectomy.	V=$\frac{20}{100}$.
133	F. 22.	R. Congenital. Nerve of other eye atrophic. Feeble perception.	Ether. Graefe. 17 days.	None.	V=Perception of light. Nerve atrophied
134	M. 13. Good.	R. Traumatic.	Cocaine. Linear. 15 days.	Keratonyxis.	V=$\frac{20}{200}$.
135	M. 20.	R. Congenital.	Cocaine. Linear.	None.	V=$\frac{5}{200}$.
136	M. 20. Same as No. 135.	L. Congenital.	Cocaine. Linear. 48 days.		La.er, V=$\frac{10}{200}$. V=$\frac{10}{200}$.
137	M. 49. Poor.	L. Senile.	Cocaine. Graefe. 57 days.	None.	V=$\frac{20}{100}$.
138	F. 22.	R. Soft. 10 yrs.	Ether. Linear. 18 days.	None.	V=$\frac{20}{100}$.
139	M. 37. Good.	R. Traumatic. 12 days. Lens under conjunctiva.	Cocaine. Opening of conjunctiva. Lens removed with spoon. 22 days.	None.	V=$\frac{18}{200}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
140	M. 45. Good.	L. Dislocated lens forward.	Cocaine. Linear. 17 days.	None.	V=$\frac{20}{200}$.
141	M. 47.	R. Traumatic.	Cocaine. Linear. 43 days.	Keratonyxis. 3 times.	V=$\frac{20}{50}$.
142	M. 51. Good.	L. Senile.	Flap, lower section. Beer's knife.	None.	V=$\frac{20}{70}$.
143	M. 51. Same as No. 142.	R. Senile.	Flap, lower section. Beer's knife. Lens dislocated into vitreous.	None.	V=$\frac{20}{200}$.
144	M. 60. Asthma.	R. Senile. 2 yrs.	Flap. Beer's knife. 20 days.	None.	V=$\frac{20}{60}$. 20 yrs. later, V same.
145	M. 65. Fair.	L. Senile.	Lens dislocated and removed with hook. 28 days.	None.	V=$\frac{16}{200}$.
146	M. 59. Good.	R. Senile.	Flap. Beer's knife. Iridectomy. 14 days.	None.	V=$\frac{20}{40}$, observed for 10 yrs. after.
147	F. 76. Good.	L. Senile. 7 yrs.	Lower section. Beer's knife. Iridectomy. 21 days.	None.	V=$\frac{20}{100}$.
148	F. 76. Same as No. 147.	L. Senile. 7 yrs.	Upper section. Beer's knife. Iridectomy. 21 days.	None.	V=$\frac{20}{200}$. Opacity cornea.
149	M. 60. Good.	R. Senile.	Lower section. Beer's knife. 21 days.	None.	V=$\frac{10}{200}$.
150	M. 60. Same as No. 149.	R. Senile.	Upper section. Beer's knife. 21 days.	None.	V=$\frac{20}{200}$, observed 20 years.
151	M. 63. Same as No. 144.	L. Senile.	Flap. Beer's knife. 18 days.	None.	V=$\frac{10}{70}$. Later, V=$\frac{20}{40}$.
152	M. 52. Good.	R. Senile.	Ether. Simple. Beer's knife. 28 days.	None.	V=objects.
153	F. 65. Good.	R. Senile.	Graefe. Patient very restless after, and kept head moving from side to side. Suppuration of cornea. 4 weeks.	None.	V=Quantitative Perception.
154	M. 65. Good.	L. Senile.	Liebreich.	Keratonyxis.	V=$\frac{20}{100}$. 10 yrs. later, V=$\frac{20}{70}$.
155	M. 76. Good.	R. Senile. 2 yrs.	Ether. Graefe.	Keratonyxis.	V=$\frac{20}{60}$. Later, V=$\frac{20}{70}$.
156	F. 72. Good.	Senile.	Graefe.		V=$\frac{20}{70}$.
157	M. 87. Good.	L. Senile. 12 yrs.	Lower section. Lens removed with spoon. Vitreous lost.	Keratonyxis.	V=$\frac{18}{200}$.
158	M. 72. Good.	L. Senile. 7 yrs.	Ether. Graefe.	None.	V=$\frac{20}{70}$, observed 10 yrs. later
159	F. 67. Insane.	R. Senile. 4 yrs.	Ether. Lens in capsule. 4 weeks.	None.	V=$\frac{20}{100}$.
160	M. 68. Good.	R. Senile. 2 yrs. Myopic.	Small simple corneal section. Vitreous lost.	Iridectomy. Iridotomy. Keratonyxis.	V=$\frac{9}{200}$. Later, V=$\frac{10}{200}$.
161	F. 74.	R. Senile.	Lens in capsule,		V=$\frac{20}{200}$.
162	F. 61. Good.	L. Senile.	Ether. Section downward. Iridectomy.	None.	V=$\frac{20}{70}$, observed 10 yrs. after
163	M. 28. Brother of No. 130.	R. Congenital. Slowly developing.	Ether. Lens in capsule. Two needlings previous without effect. 2 months.	Iridotomy.	V=$\frac{20}{70}$.

♂ ♀	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
164	M. 28. Same as No. 163.	L. Congenital.	Ether. Graefe. Small corneal section. Iridectomy. 3 months.	Iridotomy.	V=$\frac{10}{200}$.
165	M. 72. Good.	R. Senile.	Ether. Lens in capsule. Iris cut. Vitreous lost from coughing. Imperfect etherization. 3 months.	None.	Panophthalmitis.
166	F. 62. Feeble.	L. Senile.	Section downward. Iridectomy.	None.	V=$\frac{20}{70}$. 3 mos. later, iridochoroiditis & V=$\frac{18}{200}$.
167	F. 66. Chr. bronchitis.	R. Senile. 2 yrs.	Graefe. Upper section, Iridectomy.	Keratonyxis twice.	V=$\frac{20}{200}$.
168	F. 70. Same as No. 167.	L. Senile. 7 yrs.	Cocaine. Förster 1 year before. Lens in capsule.	None.	V=$\frac{20}{40}$, observed 4 yrs. later.
169	M. 75. Good.	L. Senile. 2 yrs. Lach. catarrh.	Ether. Lower section. Iridectomy. Vitreous lost. 35 days.	None.	V=Perception of light.
170	M. 60. Alcoholic.	R. Senile. 1 yr. Myopic.	Ether. Graefe. 21 days.	None.	V=$\frac{20}{70}$. Detachment of retina 4 years later.
171	M. 51. Son of No. 155.	L. Senile. 3 yrs. Myopic.	Ether. Lens in capsule. Vitreous lost. 21 days		V=$\frac{20}{40}$, observed 7 yrs. after.
172	M. 36. 2d son of No. 155. Delicate.	R. Senile. 4 yrs.	Cocaine. Lens in capsule. 21 days.	Keratonyxis.	V=$\frac{20}{50}$.
173	F. 59. Good.	Senile.	Simple. Beer's knife.	Keratonyxis.	V=$\frac{15}{200}$.
174	F. 53. Good.	R. Senile. 4 yrs.	Cocaine. Lens in capsule. Section downward. 21 days.	None.	V=$\frac{20}{100}$. Later, V=$\frac{20}{70}$
175	F. 60. Poor.	R. Senile. Glaucomatous.	Ether. Graefe.	None.	V=$\frac{20}{70}$. 4 years later, V=$\frac{8}{200}$.
176	M. 65. Bronchitis. Gout.	R. Senile.	Cocaine. Lens in capsule. Hit his eye after operation. Suppuration. 6 wks.	None.	Phthisis bulbi.
177	F. 44. Daughter of No. 144. Delicate.	R. Senile. 5 yrs.	Cocaine. Simple. 28 days.	Keratonyxis twice.	V=$\frac{20}{40}$.
178	F. 59. Feeble.	R. Senile. 6 mos.	Cocaine. Simple. Vitreous lost. 28 days.	None.	V=$\frac{20}{70}$+.
179	F. 93. Good.	R. Senile.	Cocaine. Lens in capsule. 28 days.	None.	V=$\frac{20}{70}$, observed 5 yrs. later.
180	M. 82. Good.	R. Senile. 2 yrs.	Cocaine. Preliminary iridectomy. Cornea collapsed.	None.	V=$\frac{20}{70}$. Later, V=$\frac{8}{200}$.
181	F. 60. Good.	L. Senile. 6 mos.	Cocaine. Simple. Capsule divided with knife. 28 days.	None.	V=$\frac{20}{50}$.
182	F. 75. Good.	L. Senile. 3 yrs.	Cocaine. Preliminary iridectomy. Lens in capsule.	Iridotomy.	V=$\frac{20}{200}$+.
183	M. 39. Good.	L. Senile. 1 yr.	Cocaine. Linear. 21 days.	None.	V=$\frac{20}{30}$. Later, V=$\frac{20}{20}$.

No.	Sex. Age. Health.	Eye. Quality. Duration.	Anæsthetic. Operation. Length of Treatment.	Secondary Operation.	Result.
184	F. 67. Fair.	R. Senile. 11 yrs.	Cocaine. Lens in capsule. 2 months.	Iridectomy of prolapsed iris.	Enucleation. Panophthalmitis.
185	M. 76. Good.	R. Senile. 2 yrs.	Cocaine. Preliminary iridectomy. Lens in capsule. 21 days.	None.	V=$\frac{20}{70}$, observed 3 yrs. later.
186	F. 64. Feeble. Same as No. 178.	L. Senile. 4 yrs.	Cocaine. Simple. Suppurative iritis after wound had closed and V was good. 3 months.	None.	V=objects.
187	M. 38. Good.	R. Soft. 5 yrs.	Cocaine. Linear with iridectomy. 2 months.	Keratonyxis.	V=$\frac{20}{70}$.
188	F. 82. Good.	L. Senile. 10 yrs.	Cocaine. Simple. Much soft cortical left.	Iridotomy and linear section.	V=$\frac{10}{200}$.
189	M. 27. Good.	L. Soft. 1 yr.	Cocaine. Linear after capsulotomy. 21 days.	Keratonyxis twice. Observed for 3 years.	V=$\frac{20}{20}$+.
190	M. 27. Same as No. 189.	R. Soft. 1 yr.	Cocaine. Linear after capsulotomy. 21 days.	Keratonyxis.	V=$\frac{20}{70}$. Later, V=$\frac{20}{30}$.
191	F. 60. Good.	L. Senile. 1½ yrs.	Ether. Graefe.	None.	V=$\frac{9}{100}$.
192	F. 58. Poor.	Senile. 3 yrs.	Ether. Graefe.	None.	V=$\frac{20}{200}$.
193	F. 55. Good.	R. Senile. 4 yrs.	Lens in capsule. 9 days.	None.	V=Counts fingers.
194	M. 82. Good.	R. Senile. 2 yrs.	Graefe. 5 days.	None.	V=Counts fingers.
195	F. 81. Good.	R. Senile. 12 yrs.	Lens in capsule.	None.	V=$\frac{20}{100}$.
196	F. 41. Good.	R. Senile. 4 yrs.	Graefe. Vitreous lost.	None.	V=$\frac{7}{200}$.
197	F. 63. Good.	R. Senile. 6 yrs. V.F. imperfect	Graefe. 6 days.	None.	V=$\frac{2}{200}$.
198	M. 69. Good.	L. Senile.	Section downward.	None.	V=$\frac{20}{40}$.
199	F. 70. Good.	L. Senile. 1 yr.	Section downward.	None.	V=$\frac{20}{70}$.
200	M. 60. Poor.	L. Senile. Tremulous iris.	Section downward. Vitreous lost. Lens removed with hook.	None.	V=$\frac{20}{100}$.
201	M. 73. Good.	L. Senile. 5 yrs.	Section downward.	None.	V=$\frac{20}{40}$.
202	M. 54. Poor.	L. Senile. 2 yrs.	Lens in capsule.	None.	V=Perception of light.
203	M. 72. Good.	R. Senile. 15 yrs.	Ether. Lens in capsule.	None.	V=$\frac{20}{40}$.
204	M. 76. Good.	L. Senile. 6 yrs.	Ether. Graefe. 16 days.	None.	V=$\frac{20}{40}$.
205	F. 61. Poor. Same as No. 109.	L. Senile. 3 yrs.	Cocaine. Graefe.	None.	V=$\frac{20}{40}$.
206	M. 44. Good.	R. Soft. Inflammatory. Myopic. Feeble perception.	Cocaine. Linear and suction with Panas syringe.	None.	V=Perception of light.

CONDITION OF EYE BEFORE OPERATION.

Myopic	Nos.	40, 127, 160, 170, 171.
V. F. imperfect	"	73, 111, 112, 197.
Glaucomatous	"	52, 175.
Choroiditis	"	80, 86.
Inflammatory	"	45, 62, 63, 124, 206.
Atrophy of optic nerve	No.	133.
Amblyopic	"	118.

Traumatic, 126, 134, 141.
Traumatic and dislocated, 139 and 140.
Congenital, 104, 119, 123, 130, 133, 135, 136, 163, and 164.
Capsular, 131.
Soft, 138 and 189.

TABLE SHOWING THE GENERAL RESULTS.

	No. of Cases.	
Vision $\frac{20}{20}$	5	
" $\frac{20}{30}$	10	
" $\frac{20}{40}$	16	
" $\frac{20}{50}$	10	
" $\frac{20}{70}$	28	
" $\frac{20}{100}$	34	
" $\frac{20}{200}$	33	
" $\frac{15}{200}$	7	
" $\frac{10}{200}$	17	
" $\frac{6}{200}$	7	
	—	167
" Counts fingers,	11	
" Perception of light,	17	
No vision,	11	39
		206

160 patients had one eye operated upon = 160 operations
23 " " both eyes " " 46 "

Total, 183 patients 206 operations

Cases No. 133, and No. 206 being excluded, of the remaining 204 cases, 167, or 82 %, were successful; 37, or 18 %, were unsuccessful.

94 males. 89 females.

KIND OF OPERATION.	VISION.														
	20/20	20/30	20/40	20/50	20/70	20/100	20/200	20/400	20/200	20/800	Count Fingers,	Perception of Light,	No. Vision,	Total,	
Liebreich,					2	2	1	1						6	No failure.
Simple, Beer's knife,			1	1	2	2	2	2			1			11	1 failure.
Simple, Beer's knife lower section,					2		3							5	No failure.
Simple, Graefe's knife,	2	1	4	4		3	2		5	1	2		1	25	3 failures.
Simple, Graefe's knife lower section		1			1	3	2		2			1		10	1 failure.
With iridectomy, Beer's knife,			1			2	1							4	No failure.
With iridectomy, downward,		1			2	4	2					1		10	1 failure.
After preliminary iridectomy,		2	2		4	3	3	1	4	2	1	6	1	29	8 failures.
Graefe,		1	3	1	7	6	4	3	3	4	5	6	4	47	15 failures.
Lens in capsule,	1	3	5	3	6	7	9		1		2	2	5	44	9 failures.
Linear,	2	1		1	2	2	3		2			1		14	1 failures.
For lens dislocated under conjunctiva,							1							1	
Total,	4	11	16	10	28	34	33	7	17	7	11	17	11	206	

It may be justly said of these statistics, that they have been made up in the light of years of knowledge of the subsequent history of the cases, and, if the eye has been lost after a few months, or within any period to entitle it to be classed as within the proper time of the operation, the fact has been stated. Some of them had better vision within a month of the operation than they finally secured, and they would, in some instances, have been the better for a secondary operation, which they declined or did not wish for, being content with useful vision—that is to say, enough to go around with and to help themselves. The vast majority of the individuals were in the poorer walks of life, who are notoriously not exacting about their visual power, $\frac{20}{100}$ or $\frac{30}{70}$ being very satisfactory to them.

The cases of suppuration of the flap were, Nos. 23, 26, 95, 99, 101, 103, 113, 134, 157 of the table, all in sequence, except Nos. 134 and 157, which belong between Nos. 26 and 95 in order of time. Two, 95 and 99, were lost within a short time of each other at the hospital.

The eye was lost from suppuration of the cornea in 9 cases. From the patient's own negligence, in two certainly of the 37 cases of failure.

THE CASES WHICH DID NOT LEAVE THE PATIENTS WITH USEFUL VISION.

An analysis of some of these may be interesting, because I think it will be generally conceded that it is important to determine the causes of failure.

A middle-aged man in easy circumstances and of very full habit. He had a successful operation on the other eye. The technique of the operation was good, but iridochoroiditis set in, blocked up the pupil, and left him with simply perception of light. I never had an opportunity to perform any other operation, or it is probable that he would have been improved. The operation was performed in rather a poor hotel, but probably the comforts he had there were as many as he had at home.

A man, aged fifty-four. There was a good projection, but the cataract was traumatic, the eyeball having been injured by concussion. The other eye was lost from a wound by a knife; but there was no sympathetic inflammation. The prognosis was not good, and the eye ended where it began, with perception of light. I am unable to say in exactly what condition the choroid was.

A country woman, of about seventy years of age. This case has already been referred to. Here also the operation was without accident. It was performed with Beer's knife; no anæsthetic was used, and the patient went through the operation very well, having apparently nerved herself up to it. But she immediately began to move her head with a regular motion from side to side, as if she had a disease of the medulla. She displayed other symptoms of intense nervous excitement. Suppuration of the flap set in on the third day, and the eye was lost.

I conceive that the suppuration here was induced by the movements of the eye, communicated from the head, and that the inflammation was essentially traumatic in origin. The reason I have not been able to give my full assent to the Listerian doctrines of sepsis as the first cause in all

cases of suppurating processes may be found in such cases as this one. I do not imagine that any ante-precautions in the face of this nervous excitement, producing a mechanical irritation, would have prevented suppuration. Coaptation of the flaps is essential, we all admit, to healing. This was prevented in this case by what has been detailed.

A man of seventy years. This case I had watched for years, with slowly developing cataract, he having had a serious attack of serous iritis, during the course of the time. His eye, however, had recovered perfectly, and was white, with good tension, good field; when I operated upon him there were few synechiæ. He was an exceedingly anxious, fretful old man, who took ether badly, and just as the section was being finished he was attacked by coughing, the lens was extracted with difficulty, the vitreous began to come out and was fastened in the wound. The eye was lost from the first and after a tedious period of inflammation from irido-choroiditis. He died without an operation on the fellow-eye, some four years after.

A man, aged seventy-five, in good health, with a slight lachrymal catarrh. The wound closed, but was infected by inflammation of the sac, and the eye was lost, not by suppuration, but from plastic inflammation, probably by this infection. I subsequently operated upon the other eye, removing it in its capsule with success.

Another case of failure was that of a poorly nourished man of sixty-five years of age (case 176). The right lens was opaque; there was a good visual field. In the left eye there was no absorption of light; the lens was cataractous and dislocated. The right lens was removed in its capsule, cocaine being used. There was no difficulty met with in the extraction, no trouble of any kind. It was a beautiful operation, which was witnessed by his family physician, Dr. Vosburg, of this city. The eye was bandaged five days afterward, the patient not having suffered from pain or discomfiture. The cornea was found to be hazy; hypopyon existed. The eye was lost by panophthalmitis. He was said to have struck his eye. The patient was gouty and had a cough. An attack of gout in the feet occurred during his first days of treatment. It seems to me that in this case the general nutrition possibly the injury, and not defects in the technique, were the provoking causes of the disease of the cornea.

Two cases of suppuration of the cornea leading to total loss were 95 and 99 of the table. Both occurred in very feeble old women; one died soon after she left the hospital, having senile dementia, the other had large ulcers on the leg. The hospital was just then, I thought, in not a good condition, for erysipelas had been in the wards.

SUBSEQUENT DETACHMENT OF THE RETINA.

One of the interesting but ultimately unfortunate cases, No. 170 of the table, occurred in an intemperate gentleman of sixty years, upon whom I performed Graefe's operation and got a good result. Vision, $\frac{20}{100}$, which afterwards, I improved to $\frac{20}{40}$. Some four years after my operation he suffered a detachment of the retina in that eye. This occurred in London, and Dr. Brudenell Carter operated upon the detachment by scleral puncture, without success; he also operated on the left eye for cataract. The vision of that eye had remained good when I saw him some months after the operation.

In another case, No. 118 of the series, detachment of the retina occurred nine months after the operation. The eye was myopic, and with marked choroiditis disseminata. The second eye, also an unsound one, was operated upon (No. 127 of the table) and fair vision resulted.

CHRONIC GLAUCOMA. GOOD RESULT.

Among the remarkable cases of the series is that of a lady of sixty years of age, in very reduced circumstances, who consulted me at the Manhattan Eye and Ear Hospital in 1881 for symptoms which were shown to be dependent upon chronic glaucoma of each eye. Her vision was then $\frac{15}{200}$ with the right eye, and $\frac{20}{30}$ with the left. She was treated by the use of eserine. In 1885 she appeared at my office with her vision reduced to quantitative perception in the right eye, and to $\frac{20}{40}$ in the left. Besides increased tension, she then had cataract in each eye. There was a general milky white opacity in each eye, but the reddish glare of the fundus could be seen through it; the tension was positively increased on the right side, less positively so on the left. On this point Dr. Emerson and I differed, he thinking it was positively increased, while I was not certain. After a preliminary iridectomy in December, 1886, the lens was removed under ether in October, 1887, with a subsequent needling through a tedious

course, considerable cortex having been left behind, the wound not being quite large enough; $\frac{20}{100}$ vision, amply sufficient for her to go about everywhere alone, resulted.

I consider this a very fortunate case, for one eye was entirely lost by chronic glaucoma, and the other, although having probably the same affection with cataract supervening, has been saved for a period of more than five years with comfortable vision. Her vision has remained four years, as above stated.

UNSUCCESSFUL ATTEMPT TO REMOVE LENS IN CAPSULE.

One of the cases in which a certain degree of useful vision was obtained ($\frac{2}{10}$), but which was very unsatisfactory to the patient, and for which he blamed me very much, was that of a gentleman of eighty-one. A preliminary iridectomy was performed, because the cataract was very slow in ripening, I having watched it for years. The operation was performed under cocaine, and I attempted to remove the lens in its capsule, but it fell backward into the vitreous humor, and I could not secure it until I had lacerated the capsule, and extracted it in that way. There was a very slight loss of vitreous. The patient made a slow recovery, and capsulotomy was performed. There were floating bodies in his vitreous, and his vision was moderate, as stated above.

This patient was operated upon three years ago. He is still living.

This and the preceding case emphasize the opinion, which I believe to be correct, that slowly maturing cataracts are comparatively bad cases for operation. Such cases always have choroids that are not entirely healthy, or at least not nearly so healthy as those of cataracts that mature steadily and regularly. It is no doubt true, as a rule, that the nuclear cataract is the one offering the best prognosis, and that those where the cortex is chiefly affected are the slowly ripening ones; but it is a rule with exceptions.

Delirium has occurred in five cases. In one, that of a lady of ninety-three years of age we were obliged to give up all ideas of keeping the eyes even shaded (the operation—the extraction of the lens in its capsule—was witnessed by Dr. F. A. Burrall, her family physician, and the delirium, which lasted for some weeks, described by him in the *Medical Record*). We kept the room dark, or nearly dark, and allowed

the old lady her own way under a nurse, and she made an excellent recovery. I visited her when she was ninety-six years old. She was able to sit up and receive her friends and read, so far as her enfeebled intellect would allow. She lived more than three years after the operation.

HOME-SICKNESS; BAD SUBSEQUENT CARE; GOOD RESULT.

The homesickness of one hospital patient was so great that I was sent for the evening after the operation, and I found the house surgeon, assistants, nurses, and matron all standing guard over a stalwart Irishman, who insisted on going home and seeing the old woman. He had already made havoc with the bandages. I sent him home and sent some one to visit him every day, and endeavored in every way to keep the eye protected. But in spite of us he was found shaving, looking into the glass with both eyes, a few days after the operation. His surroundings were of the humblest, and he had none of the advantages of the hospital, but he made a good recovery and had good vision—$\frac{20}{40}$.

GLAUCOMA.

In one case acute glaucoma supervened upon ordinary senile cataract, and I removed the lens to the immediate relief of the symptoms of glaucoma. The eye was very deeply sunken; the operation was difficult and performed under cocaine. She had $\frac{20}{40}$ for some years. A membrane formed, but she declined an operation. Her vision was reduced by the membrane to about $\frac{10}{200}$.

In another, that of a lady of seventy-nine, glaucoma appeared in the fellow-eye while the patient was under treatment days after the lens had been extracted. She had chronic Bright's disease. The operation was complicated by senile entropion, but the lens was extracted in its capsule without difficulty, a preliminary iridectomy having been performed. The vision became $\frac{20}{100}$, with the ability to read fine type. When acute glaucoma supervened, I performed an iridectomy on the fellow-eye. I am not able to get any history of the patient later than a year after this, when she remained about the same.

Case 184 of the table was a promising one, that finally was totally lost. The patient, a female, was sixty-seven years of age. The lens was removed in its capsule, the wound healed in five days, and the patient had sharp vision for several days after.

Prolapse of the iris occurred at the 12th day. It was excised, but suppurative hyalitis set in, and the eyeball was enucleated. I have always believed that this patient interfered with her own eye by rubbing it, and that the prolapse was thus caused.

I operated in one case on a lady of sixty-seven, who was generally of sound mind, but who was subject to fits of lunacy. She had one of these during the treatment. The lens was removed in its capsule; the resulting vision was $\frac{20}{100}$. She could read No. 1 Jaeger, but for a long time she insisted that she could not see at all.

FAULTY ENTRANCE OF THE KNIFE.

In another case, that of a lady of fifty-one, I introduced the knife, intending to make an upper section; but I found its blade was pointed the wrong way, and finished with the lower. The patient made a good recovery—vision $\frac{20}{70}$,—she died a year and a half after the operation.

CASES IN WHICH SEVERAL MEMBERS OF A FAMILY HAVE HAD CATARACT.

I have operated upon a father and two sons for senile cataract. All the operations were successful, and they are all living. I have also operated on father and daughter, and a cousin of the father, in another family. I saw another cousin who had cataract, and a time was set for the operation, but he was attacked by acute disease and died. The mother of this cousin was also operated upon for cataract by a distinguished oculist.

In the family in which I operated upon the father and two sons, one son was fifty years of age at the time of the operation; the other was thirty-six. In the patient of fifty the eyes were very prominent and myopic; a small quantity of vitreous escaped; the lens was removed in its capsule; the eye recovered in eleven days; the resultant vision was $\frac{20}{50}$, which is still maintained some years afterward.

In the son of thirty-six, operated upon October 14, 1884, there was an attack of keratitis, but the vision reached was $\frac{20}{30}$, which lasted over a year, and after that was reduced by a membrane; this again being a case where, although the lens was removed in its capsule, needling had to be performed. The needling again restored vision to $\frac{20}{40}$.

The father of these brothers, Dr. J. C., was seventy-six years of age at the time of this operation, Jan. 13, 1880, which was a Graefe, and is still living with good vision, as are his sons. They are Nos. 155, 171, 172, of the table.

In the other family the father was sixty at the time of the first operation, No. 144 of the table. I operated upon his fellow-eye successfully two years later, and he lived for fifteen years after. The daughter was but forty-four years of age when operated upon, Jan. 19, 1889.

Both operations were simple extractions, the former with Beer's knife, the latter with Graefe's knife, and two subsequent operations for membrane. Both, as well as the cousin of the father, had excellent results, No. 67 of the table. In this last case I extracted the lens in its capsule with an iridectomy. The patient was a lady of sixty-three, the operation was successful; the patient returned to the hospital with pain in her eye one month after she was dismissed. She was found to have iritis and pus in the anterior chamber. After the use of hot water every two hours, and atropine, the pain disappeared, and she was discharged with the same vision as she had when she left the hospital, $\frac{2}{10}$, and she continues to have it now, some five years afterward. I had, five or six years previously, treated her successfully for lachrymal catarrh by Bowman's method.

Two other cases, brothers, in whom I have now operated upon both eyes, are remarkable, because they are both under-sized men, with good mental capacity however, and microphthalmic. Their eyes, as to the cornea certainly, and apparently as to the eyeballs, are about half the size of ordinary adults', even of those below the medium size. The lenses bore no such disproportion in size, to those of ordinary eyes, as did the cornea. They were comparatively large. The vertical diameters of the second brother's corneæ is 6 *mm*, the horizontal only 7 *mm*. That of the older is not greater.

Priestly Smith[1] after examining 500 eyes, 250 males and 250 females, gives "the healthy cornea of the living eye of persons between five and ninety years of age an average horizontal diameter of 11.6 *mm*."

[1] Transactions of the Ophthalmological Society of the United Kingdom.

The first brother, Floyd P., was twenty-eight years of age when I operated upon the right eye, Oct. 22, 1880, after vainly attempting to produce absorption by needling the lens; making no impression upon it, I removed the lens by Graefe's method, and good vision resulted; Nos. 32 and 34 of the table. Later, in November, I operated upon his fellow-eye, also successfully, and in February, 1889, upon his brother's eye, and finally, in January, 1891, upon his fellow-eye.

All of the operations have been successful, but all have required secondary operations except the last. The second brother had a diffuse opacity of the upper part of the cornea, which disappeared in ten days after, under the use of calomel. I am inclined to think that this opacity was due to the too prolonged use of cocaine, as he was very timid and insisted on having a great deal used.

REMOVAL OF LENS IN CAPSULE CONTRASTED WITH GRAEFE'S OPERATION.

A gentleman of seventy-five years of age, of Bennington, Vermont. This case is interesting because he had undergone a modified Graefe's operation on the left eye, which, after subsequent needling by another operator, had resulted in vision $\frac{20}{200}$. Floating bodies were in the vitreous humor, the patient was very much annoyed by them, and he desired to have another operation on the other eye, hoping to have none in that eye. A preliminary iridectomy was performed, the lens extracted in its capsule without accident, two weeks later. He had some senile delirium after the operation, and made a slow recovery. His vision was exactly the same as in the other eye, the floating bodies were equally troublesome, and continue so at this writing.

A lady, aged sixty-five, operated on July, 1881. This is of interest, because, like one just reported, I operated upon one eye by Graefe's method, and subsequently removed the lens of the other in its capsule. The eye first operated upon, after needling, had a resulting vision of $\frac{20}{70}$. The second, after a preliminary iridectomy, was removed in its capsule, October 27, 1886, and vision became $\frac{20}{40}$, and remains good.

There is another case in which one eye had been operated upon by another oculist by the Graefe method; the result was $\frac{20}{100}$ three

years after. I removed the lens in its capsule, and six months after the vision was $\frac{20}{60}$.

I have observed that the flaps of the cases of extraction of the capsule heal much less readily than those of ordinary, simple extraction. This is probably due to the fact that the iris has been pushed a little out of place, when the lens emerges, and that this assists in causing the wound to gap. I think it important, where this operation is performed, that pains should be taken to replace the iris. As I have said, I have nearly abandoned the operation, because, while much more difficult than the simple extraction, the chief result which I hoped to secure—that is, the avoidance of pupillary membrane,—was not secured, and therefore it does not seem to me to have the advantage over the other operations. And yet, in one case—that of a distinguished writer of this country, given to the free use of alcohol,—I believe that the absence of the capsule as a source of inflammation, helped me to save the eye. There are certain cases in which the presence of the capsule is sure to excite tedious inflammation, which oftentimes ends in the permanent closure of the pupil. I believe that some, at least, of the cases that figure in reports published in a few months after the cases were operated upon, finally become cases of closed pupil from iritic and capsulary inflammations. In cases apparently predisposed to inflammations of the iris and capsule, the removal of the capsule is a very great advantage. Neither do I think that the trifling loss of vitreous, which is more apt to occur in an extraction in the capsule, by my method, is particularly prejudicial to a good result. A slight or even a considerable loss of vitreous does not, so far as my experience goes, predispose an eye to subsequent detachment of the retina or hyalitis, as is sometimes said.

LOSS OF ONE EYE FROM INFECTION BY LACHRYMAL CATARRH; FELLOW-EYE SUCCESSFULLY OPERATED UPON.

CASE 169 of the series. Here a man of seventy-one was operated upon, October 12, 1881, under ether. The wound was infected by lachrymal catarrh, and after it had closed it

reopened. The result was a closed pupil and perception of light. Six months after I removed the lens of the fellow-eye in its capsule, without, however, setting out to do so until the section was made and it was seen that the lens was ready to escape. The vision finally became $\frac{10}{10}$.

BAD ECCENTRIC VISUAL FIELD; GOOD RESULT.

In one case, No. 80, a woman of fifty-two, before the operation the peripheric visual field was very poor. The central perception of light was, however, good, and the result was $\frac{20}{100}$ in the central field. The ophthalmoscope showed extensive choroiditis disseminata.

HEMORRHAGE FROM THE IRIS.

Case No. 83 of table, a man of fifty-nine years of age, had a sad interest, because hemorrhage from the iris occurred after the operation upon the first eye, and finally the sight was lost. The operation on the other eye was undertaken four years later, with the precaution of preliminary iridectomy. All went well for ten days, when a hemorrhage occurred, and that gradually became absorbed. The patient secured a very moderate amount of vision, $\frac{2}{200}$, which he still maintains.

RE-OPENING OF A WOUND; SEPTIC PNEUMONIA; DEATH.

A man of sixty-five, June 2, 1888, an old soldier, who had had an operation upon the bones of the right forearm. The wound was open, but filling up by granulation. His attending surgeon considered him in as sound a condition as he would ever be. He feared nothing from this wound; but a good operation, removal of the lens in its capsule, was followed by the re-opening of his wound, with severe inflammatory action and erysipelas. The eye, however, during his illness healed perfectly, and he had good sight. It could not be positively measured, on account of his severe illness—it was certainly $\frac{20}{100}$; but he died of septic pneumonia, one month and ten days after the cataract operation. The fellow-eye had been lost by inflammation.

In four cases I have operated, in spite of the existence of chronic conjunctivitis, which, however, I had treated, for some weeks before, without, however, having subdued the inflammation entirely. In all these the result was good.

In the case of John S., aged seventy-five, No. 101, the lower section was made ; it was encroached upon after partial healing by the lower lid, and suppuration of the edge of the wound occurred, although a very moderate amount of vision was left. I think the liability to this accident is a great objection to a lower section.

I have found that not only senile delirium, but also malaria is apt to develop in persons undergoing cataract operation, or at least may develop, and I have seen benefit in malarial subjects, in keeping the patient constantly under the influence of quinine in moderate doses.

The operation of the removal of the lens in its capsule is generally followed by considerable astigmatism—more than usual in simple extraction. Among the poorer patients it was impossible to induce them to wear the proper correcting glasses. Some of my results would have been better if they had been measured with the full correction of the astigmatism.

PROLAPSE OF THE VITREOUS SOME SIX DAYS AFTER THE OPERATION ; SYMPATHETIC OPHTHALMIA ; LOSS OF BOTH EYES.

The case of T. M., aged sixty-five. Operation at Manhattan Eye and Ear Hospital, April 15, 1890, is one of sad interest. The eye was doing perfectly well four days after the operation, when he snapped his eyelids together, just after the lids had been washed, prolapsed the vitreous humor, and the eye went on to total destruction. Although the eye was promptly removed, sympathetic irritation occurred in the other, and that also was lost, in spite of earnest efforts, removal of the lens, iridotomy to secure something from the wreck, and so forth.

I think the matter of the pre-existence of myopia is not always fully appreciated in estimating as to the visual power after an operation. Schweigger has called attention to this subject; certainly statistics taken from a number of myopic patients would not give apparently as good results as those from hyperopes.

MYOPIA ; PARTIAL SUCCESS ; FIVE SUBSEQUENT OPERATIONS.

One of the series illustrating this and other points is that of a gentleman from Buffalo, of sixty-eight years, who was first oper-

ated upon by me on Feb. 10, 1879, having lost the left eye by an unsuccessful operation in the hands of another surgeon. From all accounts he never had more than $\frac{20}{100}$ distant vision with a concave glass. A modified Graefe was performed and his vision was only $\frac{8}{200}$, but he got about very well, and read large type. The pupil closed. He has had 2 needlings, 2 iridectomies, and 3 iridotomies, and in October, 1890, two years after the last operation, had $\frac{10}{200}$. Loring's operation for iridotomy was successful in his case in restoring considerable vision, when the sight was reduced to perception of light, and one competent ophthalmologist thought all chance of an improvement was gone. The patient is still living, at eighty years and upward, and has to thank his own pluck for the modicum of vision that remains to him.

One of the cases in the table was reported at a meeting of the American Ophthalmological Society, 1863, p. 69. It is one of the Liebreich operations. As I have known it to happen in another case, and in the hands of an experienced operator, the lens was dislocated, instead of being removed; but in my case, fortunately, the wound was opened one week later, the dislocated lens seized with a cystotome, and readily removed without accident, and good vision resulted.

VOMITING.

In one case in which ether was given, the patient vomited before the bandage was applied. She was very unruly, and complete prolapse of the iris occurred. The flap was bent over—it was very difficult to replace it. Suppuration followed. In another case where an excellent result was obtained, vomiting was very profuse twice after the bandage was applied, yet no harm resulted.

There were six eyes, two besides the four of the Powell family, that could properly be called microphthalmic, they were so small, yet the results were as favorable as in eyes of the proper size, although the extractions were rather more difficult.

In three cases, the patient, after having lost one eye at my hands, has consented to an operation on the other eye, and has obtained useful vision.

I remember one unfortunate case, however, not included in this table, because I have never been able to find the records, of a patient who lost one eye from suppuration of the iris, and when the wound had closed some months after, I operated on the fellow-eye with the same sad result, and yet nothing was at fault

with the technique, the wounds healed very kindly, and as in case No. 186 suppurative iritis supervened. In this latter case, I have always felt that it began with a chill, induced by a change from a sunny room to one without sunlight, and possibly infected with sewer gas. Fortunately for the patient, a previous operation upon the fellow-eye had been successful.

LINEAR EXTRACTION.

The linear extractions deserve mention:

Fourteen eyes in all were operated upon by this method; there was only one failure. They were usually begun by an incision with an iridectomy knife, not always accompanied by an iridectomy, but always when there was difficulty in removing the whole of the lens matter. Most of the cases are found in this class, but five eyes in three persons, all males, were idiopathic. When I saw them they were fully developed, and it was impossible to say positively whether or not they were congenital. In one case, that of a Catholic clergyman of 31, on whom I operated by discission in March, 1887, with a resulting vision of $\frac{20}{40}$. In 1890, when the cataract in the fellow-eye became ripe, I removed it by linear section, and saved the patient much time. The operation did well, but his vision was not, when I saw him last, two months after the operation, as good as the other, $\frac{20}{70}$. In another case, that of a dentist of Kingston, N. Y., a linear section with iridectomy, resulted in v. $\frac{20}{30}$. Case 183 of table. In a third case I operated upon both eyes, by linear section, a young man, a clerk of 27; the first in March 1887, on the fellow-eye, the right, in May, 1888. This patient gave a clear history of injuries to his head, to which he attributed the loss of sight. He had an injury from a sand-bag one year before he consulted me, and when a small boy he was hit in the forehead by a stone. He got good vision in each eye, and uses his sight all day as an invoice clerk.

The risks of a linear section are very slight as compared with those of a flap, as is well known. I think the field of its employment might be profitably enlarged. It is well adapted to many cases of cataract beside the traumatic form, for which I have, like others, usually employed it.

I have included two cases of extraction of cataract in my account, in neither of which was it expected that vision

would result. In one, the operation was performed for cosmetic reasons. The patient was very myopic, had prominent eyelids, and the deformity from the cataract was considerable. A linear incision was made, and after evacuating a small portion by pressure and counter-pressure, a very large lens was slowly extracted by the use of Panas' syringe. I think this is valuable not only for washing out the soft cortical matter, but also soft cataracts. It is a much better instrument than the old suction instrument of Teale.

This analysis might be continued in greater detail, but it has already perhaps exceeded reasonable limits. To conclude, from my present standpoint, I prefer simple extraction, of course with a narrow knife, closure of the eye with a bandage, which may be changed every twenty-four hours, if needful for the comfort of the patient, without opening the eye, after the first twelve hours. I do not insist upon a rigid decubitus; I usually instil a drop of a 1:500 solution of sulphate of eserine after the operation. I think it very important to get the cortical matter away, as do all operators I believe. For this purpose, I think Panas' syringe valuable, although as yet I have used it very little. Panas himself has given up injections of the anterior chamber with mercurial solutions, and uses a solution of boric acid. Preliminary iridectomy, with Forster's massage, is a procedure to be advised, in my opinion, in all cases where we have reason to fear, either from difficulty in the operation and from the condition of the eye, that it will be difficult to extract the lens without accident. If after making the section, it is seen that the lens will readily escape without a capsulotomy, its removal in its capsule is to be recommended. When subsequent capsulotomy is necessary I prefer Galezowski's knife; when I am obliged to perform an iridotomy, Loring's method, that with the use of a narrow Graefe's knife, seems to me the best.

ON METASTATIC CARCINOMA OF THE EYEBALL.

By Dr. JOHANN MITVALSKY.

ASSISTANT TO THE BOHEMIAN EYE-CLINIC IN PRAGUE.

Translated by Dr. WARD A. HOLDEN, New York.

(With six drawings on Plate xvii. of vol. xxi., Germ. ed.)

THE rarity of metastatic carcinoma of the eyeball, six cases only having been described, leads me to report two analogous cases observed in the eye-clinic at Prague, and to speak of some particular points in the histories which are common to all these cases.

The cases hitherto reported are as follows:

The first case, described by Perls,[1] was a metastatic carcinoma of the choroid in both eyes; an anatomical examination only was made; the lung was the seat of the primary tumor.[2]

The second case, described by Hirschberg,[3] was a metastatic carcinoma of the choroid in both eyes; a clinical examination only was made; the right mammary gland was the seat of the primary tumor.

The third case, described clinically by Schöler,[4] anatomically by Uhthoff,[5] was a metastatic carcinoma of the choroid in both eyes, which involved sclera, papilla, and optic nerve, presenting a tumor in the posterior segment of the eyeball; the left mammary gland was the seat of the primary growth.

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[1] *Virchow's Archiv*, vol. lvi.

[2] Abstracts of Cases 1, 2, 3, 4, and 6 are to be found in a paper by Schultze, ARCH. OF OPHTH., 1890, p. 228.

[3] *Centralbl. f. prakt. Augenheilk.*, p 376, 1882.

[4] *Berliner klin. Wochenschrift*, No. 7, 1883; and *Centralbl. f. prakt. Augenheilk.*, p. 236, 1883.

[5] *Ibid.*, p. 412, and Report of XV. Meeting of Heidelberg Ophth. Soc., p. 204.

The fourth case, described by Hirschberg and Birnbacher,[1] was a metastatic carcinoma of the choroid in the left eye, examined both clinically and anatomically; the primary growth was located in the right mammary gland.

The fifth case, described by Manz,[2] was a metastatic carcinoma of the choroid in both eyes, only examined clinically; the right mamma was the seat of the primary disease.

A woman, æt. 50, noticed a mammary tumor early in 1883, which was extirpated in August of the same year. Toward the end of October she noticed a cloudiness before the left eye and later before the right. Examination, middle of October, R, V= $\frac{1}{5}$; L, V= fingers at 3 feet, T not increased (L, rather diminished finally). Both eyes showed extensive detachment of the retina. Vision was finally completely lost. Patient died in December.

The sixth case, described by Schapringer,[3] was a metastatic carcinoma of the choroid in the left eye, examined clinically and anatomically; the primary growth being in the right mammary gland.[4]

The ninth case, described by Schultze,[5] was a metastatic carcinoma of the choroid in the left eye, examined clinically and microscopically; the primary growth being in the left mammary gland.

Mrs. X., æt. 34, showed a detachment of the upper outer portion of the left retina. The enucleated ball showed two distinct flat tumors. One year before, a carcinoma of the right breast was discovered and extirpated. Patient died of bulbar paralysis a few months after the ocular symptoms came on.

The tenth case, described by Ewing,[6] was a metastatic carcinoma of the ciliary body and iris in the left eye, examined clinically and anatomically; the primary growth being in the left breast.

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[1] *Graefe's Archiv*, vol. xxx., p. 113.
[2] *Ibid.*, vol. xxxi., p. 101.
[3] Schapringer, *Amer. Journ. of Ophth.*, vol. v., No 10.
[4] Since this paper was originally published, three further cases of carcinomatous metastases in the eyeball have been reported. Abstracts of these are introduced here, as Cases 9, 10, and 11.—TRANSLATOR.
[5] Schultze, these ARCHIVES, 1890, p. 227.
[6] Ewing, *Graefe's Archiv*, 1890, p. 121.

Miss B., æt. 32, complained of failing vision for three months, and showed detachment of the retina with increased tension. Eye enucleated. At this time a carcinoma as large as an apple was found in the left mammary gland.

The patient's general condition was bad and she vomited frequently.

The eleventh case, described by Wadsworth,[1] was a metastatic carcinoma of the choroid in the right eye, examined clinically and anatomically; the original disease being located in the right breast.

Miss T., æt. 46, complained of failing sight. The retina was pushed forward by a tumor, and detached peripherically. Tension was not increased. The enucleated ball exhibited a shell-shaped carcinoma with areas of hyaline degeneration. A moderately-sized carcinoma had been removed from the right breast sixteen months before.

Gayet[2] has recently described a case of metastatic tumor of the choroid, which appeared as an adenoma following an adeno-carcinomatous growth in the stomach. Since this interesting case was not one of carcinoma in the strict sense of the word, it will be passed over.

THE TWO NEW CASES.

The seventh case of metastatic carcinoma of the choroid, in the left eye, the primary growth being situated in the left mammary gland.

Franziska Kucera, æt. 46, consulted Prof. Schöbl, Feb. 16, 1886, complaining that the sight of the left eye had been failing for 2 weeks. A carcinoma had been removed from her left breast in 1884. After four months there was a local recurrence of the growth, with swelling of the axillary and supraclavicular lymphatic glands. A second operation was made, since which her condition has been good. No history of hereditary disposition. Examination of the somewhat emaciated patient showed no nodules in the cicatrix in the breast, but a number of enlarged hard lymphatic glands in the axillary and supraclavicular regions were found.

[1] Wadsworth, Transactions of Amer. Ophth. Society, 1890.
[2] *Archives d'Opht.*, Mai-Juin, 1889.

The right eye was quite normal, and the left appeared so exteriorly; L, V = $\frac{6}{120}$ with direct fixation. With the ophthalmoscope the media appeared clear. A vertically oval growth of three disc diameters extended laterally from the papilla to the macula lutea. It had a dirty yellow color, with isolated pigmented points. Its central position showed an elevation of three or four dioptries; its periphery passed gradually over into the emmetropic fundus.

The central portion of the growth exhibited small vessels of irregular course, which were not in connection with the retinal vessels and were therefore probably of new formation. T normal. Perimetric examination revealed a scotoma corresponding to the growth.

A diagnosis of metastatic carcinoma of the choroid was made.

March 1, 1886, the ophthalmoscope showed movable thread-like opacities in the vitreous, and a detachment of the retina involving two thirds of the fundus. T diminished.

March 15th, intolerable pain in eye, forehead, and head; retina totally detached. Ball glaucomatous; enucleation performed. Two months later the patient died with symptoms of metastases in the lungs and brain. The right eye remained unaffected.

The enucleated ball was hardened in a mixture of Müller's fluid and picric acid, and divided by a horizontal section. The antero-posterior diameter was 24.5 *mm*, the æquatorial 22.5 *mm* (Fig. 1). The inner third of the choroid is macroscopically normal, its outer two-thirds are replaced by a shell-shaped mass of dirty yellowish-gray color, which extends beyond the ora serrata on the temporal side, nearly reaching the ciliary body. The greatest thickness of the mass is 2 *mm*.

The growth surrounds the papilla without altering it macroscopically. The inner surface of the tumor exhibits shallow depressions, and the surface toward the sclera has a slightly wavy contour. The tumor consists of a dense framework and a brittle intervening substance. The retina shows a funnel-shaped detachment. Only the anterior portion of the choroid, particularly inward and upward, remains free from the growth.

After imbedding in celloidin, total sections of the ball were made, and also flat sections of the tumor. All the

preparations show numerous yellow spots, varying from the size of a pin-point up to that of a hemp-seed, which do not stain with the rest of the tumor, and which drop out as plug-like masses when the preparations are washed.

Microscopically the tumor presents the appearance of a carcinoma, which, as the relative proportion of connective-tissue framework and nests of epithelial cells varies in different portions, is to be considered in part a scirrhus, in part a simple carcinoma (Figs. 2 and 3). In general the central portion of the tumor, in transverse section, shows rather the character of a fibrous carcinoma, with a predominating dense connective-tissue framework, and relatively few small and isolated cell nests; the peripheral portions, however, show a more delicate connective-tissue framework, with large meshes which are filled with cell nests.

The connective-tissue framework exhibits everywhere choroidal pigment, indicating that its origin must have been in the pigmented choroidal stroma. This framework has a markedly fibrillar structure, and contains a few oval or spindle-shaped nuclei of connective-tissue cells, and a few leucocytes near the scleral surface.

The carcinoma cell nests are of all shapes and sizes (Figs. 2 and 3) and the tubules have been cut in every direction.

The yellow unstained plugs, previously mentioned, would seem to consist mostly of degenerated cells from the interior of the nests, with some pigment, and nuclei of connective-tissue cells, indicating some participation of the framework of the tumor in the process.

The principal change in those portions of the choroid which are being invaded by the carcinomatous tubules is an increase in volume; the pigment cells and the connective-tissue fibrillæ are increased in number, producing a thickening of the choroid, which is again increased by the obstruction of the circulation. Near the nasal margin of the tumor the meshes of the suprachorioidea are dilated by the remains of old hemorrhages. The choroidal veins are dilated and many of the arteries are small. There is no marked infiltration of round cells about the vessels. The tumor here spreads chiefly in the suprachorioidea, and the neighboring

vessels are dilated and filled with degenerated blood corpuscles.

At the temporal margin (Fig. 3), however, the carcinoma is seen to be developing mostly in the ground-substance of the choroid, below the chorio-capillaris. The vessels are moderately dilated. The suprachoroidal space is enlarged and is the seat of an extensive hemorrhage (Fig. 3 *b*). Some preparations show carcinomatous nests within the hemorrhage, either connected with other tubules or isolated (Fig. 5). These evidently represent carcinomatous processes growing through the hemorrhage. The lamina vitrea is everywhere preserved and covers the inner surface of the tumor, following its elevations and depressions. The inner surface of the lamina vitrea is covered with pigment epithelium, raised here and there by a homogeneous exudate. The epithelial cells have lost their pigment for the most part and are undergoing a hydropic degeneration.

The retina is well preserved for the most part, showing, however, a dilatation of its blood-vessels, a displacement of the rods and cones, and a cystoid degeneration peripherically.

The papilla has not become involved in the growth, the vitreous shows a fibrous contraction, the lens is normal. The iris and ciliary body are unchanged, the chamber angles are open, the anterior chamber is filled with a fibrinous exudate. The cornea is unchanged, the sclera shows a round-celled infiltration in places, the bulbar conjunctiva is thickened and infiltrated with round cells, particularly about the vessels.

REMARKS ON THE ANATOMICAL CONDITION OF THE BALL IN OUR FIRST CASE.

While in its clinical course our case differs in no important particulars from those previously described, it shows one histological change, which has not been noted in the other cases, viz., the presence of a number of degenerated foci, which have been described above. At first glance these degenerated foci seemed to be the necroses which are often found in old carcinomata, but, studied more closely, their peculiarities and their relations to the surrounding parts

seem to render this view improbable. Let us first see whether these degenerated parts have arisen in the same manner as those which we are accustomed to see in carcinomatous tumors, and which arise, as is known, through retrograde changes, such as mucoid, hydropic, and fatty degeneration.

Were this the case, we should be able to find all the successive stages of the metamorphosis. Under a high power, however, no carcinoma cells are found which exhibit signs of any of these degenerations, although had the necrosis been caused in this manner, the cells about the necrotic foci should exhibit some changes of this sort.

This is another point also which speaks against this origin of the necrotic foci. It is evident that, in an extensive carcinomatous necrosis, the carcinoma tubules, as well as the connective-tissue framework which supports them, might be destroyed, and it would not have surprised us to have found a quantity of choroid pigment within such a necrotic mass. But the case is different when a small necrotic focus crowded with pigment is discovered within a normally formed and well-preserved carcinoma tubule, while the tubule itself shows no trace of pigment. Here we are compelled to acknowledge that the necrotic portion could not have arisen from the surrounding carcinoma cells, since in such a case it must have been free from pigment.

If a preparation of the tumor be observed through a magnifying glass, the large hemorrhages which were noticed particularly in the suprachoroidal space at the temporal margin of the tumor (Fig. 3 *b*), are seen to resemble the necrotic foci both in color and in general appearance. Microscopically, also, the hemorrhages have the same yellow color as the necrotic foci.

As has been said, the hemorrhages are only well preserved in their anterior portions; posteriorly toward the developing carcinoma, the hemorrhages with their fibrinous networks degenerate into a finely granular mass, in which may be seen leucocytes, swollen cells of the connective-tissue tracts, and pigment epithelial cells which have lost most of their pigment. Between these, clumps of free-lying choroidal pigment are seen. The carcinoma cells are seen spreading toward the

hemorrhages, following the connective-tissue septa (Fig. 3 *c*), and even in the hemorrhages themselves we see carcinoma tubules, either connected with the neighboring tubules or already separated from them (Fig. 5). When it is seen that these hemorrhages exist also on the nasal side, and that from the obstruction of the circulation the conditions were not favorable to their resorption, what else can one suppose but that these hemorrhages, instead of being absorbed, coagulated into unformed masses, which eventually became surrounded by the developing carcinoma cells? The central or more eccentric final position of the mass in its sheath of carcinoma cells, depends upon the further development and increase of these latter. If now a portion contained within a small mesh be surrounded by the carcinoma cells, a small apparently necrotic focus results, which may be entirely colorless, or which may contain a greater or less quantity of choroidal pigment. When larger portions are involved, some tracts of connective tissue are also included, and these degenerate for the most part, and are represented only by clear stripes and tracts of pigment. In this manner the connective tissue of the focus is separated from the surrounding tissue, and but a trace of it is found here and there in a sequestered portion.

A number of other facts point toward such a manner of development for the necrotic foci, and the existence of all of them may be easily explained in this way. The development of the very small foci is probably as follows: the cells of the carcinoma tubule endeavor to spread into the interior of a necrotic focus following a bundle of connective tissue, but the carcinoma cells are only able to surround some small portions in the smallest peripheric meshes, and these being cut off become separate small foci.

Some of these small foci may arise in another manner. The clear wall of some of these contains nucleated spindle-cells, and the shrunken, yellow, necrotic contents are seen to be separated from the wall, leading one to believe that this had been a capillary, whose contents had undergone a granular degeneration. We may suppose that in consequence of the obstruction to the circulation which the

tumor caused, a number of dilated capillaries were cut off from the general circulation and the blood contained within them coagulated.

If the periphery of the tumor be examined, three stages of the process by which the carcinoma cells invade the necrotic foci may be followed. The freshest foci of the periphery, partly surrounded by carcinoma cells, show a number of scattered darkly stained nuclei, but these are not more numerous near the sheath of carcinoma cells. Later the peripheric zones of the focus, near the sheath, show a considerable increase in nuclei, evidently from the neighboring carcinoma cells, but the necrotic focus is still closely connected with its sheath of carcinoma cells. In the latest stage these nuclei are rarely found, but the necrotic focus is separated from its sheath by a free interval. The first stage is that in which the cells develop in one direction, forming a tubule; the second that in which the tubule ceases to develop longitudinally, but becomes thicker; the third that in which the necrotic focus becomes surrounded and appears cut off from the living tissues, like a sequestrum.

There is a further peculiar appearance to be spoken of. In the periphery of the tumor, in the centre of large nests of carcinoma cells, there are found parts which consist only of these darkly stained nuclei, held together by a yellow homogeneous cement-substance (Fig. 6 *a*). This is, however, nothing else than the peripheral portions of necrotic foci surrounded by carcinoma cells in the first and second stages, cut tangentially.

Let us consider now the development of the tumor. The carcinomatous metastasis has occurred in the central portion of the choroid, from which it has spread in all directions, so that the two temporal venæ vorticosæ have soon been surrounded, and the circulation through them blocked. This has caused a marked dilatation of the vessels, and the veins have burst from the distention, permitting the escape of blood, or their walls have been eroded by the carcinoma cells, so that repeated hemorrhages have occurred in the periphery of the tumor. But since the conditions for

resorption were unfavorable the hemorrhages have undergone a granular degeneration, and have coagulated later into masses, whereby the tumor has been forced to change its previous structural character of a simple carcinoma, since the cells have been compelled to spread along the connective tissue surrounding or pervading the coagulated masses, and the cellular sheaths described above have been formed.

If the presence of crystallized blood pigment could have been demonstrated in the coagulated masses, our hypothesis as to their origin would have been proven. A negative result, however, would not speak against our hypothesis, since the specimen had been hardened in Müller's fluid and picric acid, both of which agents render the test of Quincke with ammonium sulphide, and Perls' iron reaction with potassium ferro-cyanide, very uncertain or negative. And in fact both the tests resulted negatively in this case, but neither were they positive in the case of the degenerated corpuscles in a large unquestionable hemorrhage near the temporal margin of the tumor.

The eighth case was a metastatic carcinoma of the choroid in the left eye, a clinical examination only having been made; the seat of the primary tumor was the left breast.

Skrivan, Franz, æt. 35, came to our clinic October 25, 1887, complaining of failing vision in the left eye. He had always been healthy until October, 1886, when he noticed a hard lump near the left nipple, which developed in a relatively short time into a large tumor, which was diagnosed carcinoma, and was removed, together with the axillary glands involved, in March, 1887. Microscopically the tumor presented the usual appearance of a scirrhus.

Status præsens.—Axillary and supraclavicular glands enlarged. Right eye normal; in the left eye the media are clear, but an irregular vertically oval, elevated tumor is seen, extending from the macula lutea some four disc diameters toward the temporal side, of a dark yellow, dirty color, with white patches here and there, and occasional pigment accumulations. Its greatest elevation is four dioptries. T normal. $V = \frac{6}{60}$, with eccentric fixation.

The growth developed rapidly; opacities of the vitreous

appeared; and the retina became detached. Metastatic tumors developed in the cranial periosteum, and the patient died with cerebral symptoms in December, 1887.

GENERAL REMARKS IN REGARD TO THE CASES OF METASTATIC CARCINOMA OF THE EYEBALL PREVIOUSLY REPORTED.

Eight[1] cases of pure carcinomatous metastasis have been observed in the eyeball, five of which (those of Perls, Schöler-Uhthoff, Hirschberg, Birnbacher, Schapringer, and our first case) were examined anatomically; while the other three (those of Hirschberg, Manz, and our second case) were only studied clinically.

The seat of the primary growth was the mammary gland in seven cases, 87.5 per cent., and in but one case, 12.5 per cent., did it show another location—that of the pleura in Perls' case.

The age of the individuals affected varied, the youngest being 28, three being between 30 and 40, two between 40 and 50, and the other two over 50, the eldest being 52. Six cases occurred in females, two in males.

It is not surprising that the ocular metastases were always in the choroid, since the detached carcinoma cells would be much more likely to enter one of the twenty short ciliary arteries than the single central retinal artery, whose lumen is almost equal to that of the ciliary arteries. It is, however, possible for a metastatic carcinoma to develop in the retina, since Schiess-Gemuseus has reported a case of sarcoma which had been followed by metastases in the papilla and the neighboring portion of the retina.

Since the germs of the metastasis are mostly single cells, the first beginning of the metastases must take place in those layers of the choroid which have the smallest vessels, viz., Sattler's layer and the chorio-capillaris, and the first development probably occurs within the lumen of the vessel; soon, however, the choroidal stroma thickens and forms the framework for the carcinoma. Schöler-Uhthoff say that

[1] Eleven cases have now been reported.

carcinoma cells are distinctly seen within the lumen of the vessels; Hirschberg-Birnbacher say, however, that no carcinoma cells were found within the vessels in their case. In my case, single nests of carcinoma cells seemed surrounded by typically distended vessels walls.

The tumors may be either shell-shaped or tuberous in form, and we may employ the terminology which Fuchs[1] has suggested for the uveal sarcomata, calling the former diffuse and the latter circumscribed. Seven of the cases described belong to the diffuse variety, and one, that of Hirschberg-Birnbacher, was distinctly tuberous.

Histologically the metastatic growth corresponded to the primary one as a rule, the type being usually that of a carcinoma simplex or a scirrhus.

In half the cases only the left eye was affected, the primary growth being in two cases in the left mammary gland and in two cases in the right. In the other four cases the metastases were bilateral, both eyes becoming affected simultaneously, or one shortly after the other, the metatastic process being probably the same in both.

The intra-ocular tension varies greatly in these cases. Hirschberg found the tension diminished; in Schapringer's case and our second case it was normal; Manz found it not diminished; in the Schöler-Uhthoff case and in our first case a consecutive glaucoma developed. The condition of the tension then throws no light on the diagnosis. In the present condition of our knowledge the variation cannot be satisfactorily explained.

The clinical course of the disease should be spoken of. The first beginning of a metastatic carcinoma is rarely seen. Hirschberg, in his case, found the media clear, several small yellow foci being seated close to the papilla, and in the other eye a larger diffuse thickening of the choroid was seen, which elevated the retina 1.5 *mm.* The tumors grew rapidly and the retina soon became detached. In all the cases, where the case was seen at an early stage, the periphery of the fundus was normal. Later, opacities of the vitreous appeared, and the retina became detached downward and

[1] Fuchs: "Das Sarcom des Uvealtractus," p. 115, Vienna, 1882.

finally totally. Schöler noticed a considerable detachment of the retina, which at a later examination, shortly before the death of the patient, had disappeared.

In some of the cases in which the tumor was shell-shaped the retina was pushed forward, causing a more hyperopic refractive condition of the eye. In but one case (Schöler-Uhthoff), was there an extra-bulbar development of the tumor, which was revealed first by a papillitis. All the cases showed a rapid growth of the tumor.

It is interesting to notice the interval which elapsed between the first appearance of the primary tumor and the development of the metastasis, as well as that which elapsed between the first appearance of the metastasis and the fatal ending.

In Hirschberg's first case the primary growth had developed for nine years before the first ocular symptoms appeared, after which death followed in a year. In the Schöler-Uhthoff case, the primary tumor lasted six years before the vision began to fail, after which death followed within a year. In the Hirschberg-Birnbacher case, the length of these intervals is not expressly stated; the latter interval would seem however to have been but a few months. In Manz's case the metastasis came on nine months after the discovery of the mammary tumor, and death followed some months later. In Schapringer's case the metastasis appeared two years after the amputation of the first, and death occurred four months later. In our first case two years elapsed before the eye became affected, and the patient died three months later. In our second case the ocular symptoms appeared somewhat more than a year after the discovery of the mammary tumor, and the patient died three months later.

It is thus seen that the metastases in the eye came on in the same manner as do those in other parts of the body, that like the latter they appear at a varying interval after the development of the primary tumor, and that like the other metastases they are a sign of the approaching end, which in the cases known came after an interval varying from three months to a year.

The discovery of a metastatic carcinoma in the eye may

be of practical interest in fixing the date of the lethal ending, and also in diagnosis when metastases of internal organs cannot be discovered by physical means. It might also be of value in enabling us to differentiate between an inflammatory and a neoplastic disease—*e. g.*, of the pleura or pericardium.

The diagnosis is not difficult.

The therapy consists in combating the symptoms, and enucleation should be done only when the pain of a consecutive glaucoma is not relieved by an iridectomy or sclerotomy.

Explanation of the Figures.

FIG. 1.—Section of eyeball, natural size.

FIG. 2.—A portion of the tumor slightly magnified. *a.* Necrotic foci with no trace of choroidal pigment. *b.* Necrotic foci with tracts of pigment.

FIG. 3.—Section through the temporal margin of the tumor. *a.* Necrotic focus with scattered nuclei. *b.* Large hemorrhage in the supra-choroidal space. *c.* Tracts of carcinoma cells developing along the course of connective-tissue septa, toward the hemorrhage. *d.* Lamina vitrea with the pigment epithelium.

FIG. 4.—A necrotic focus surrounded by a crescentic sheath of carcinoma cells, highly magnified. The difference between the two sorts of nuclei is distinctly shown only in the periphery of the focus.

FIG. 5.—An isolated group of fresh carcinoma cells, situated in the middle of the large supra-choroidal hemorrhage, adherent to a connective-tissue bundle.

FIG. 6.—Section through a carcinoma tubule, in which the periphery of a necrotic focus has been touched, recognizable by the group of darkly stained nuclei (*a*).

A CASE OF PERIVASCULITIS RETINÆ.

(REPORTED FROM THE OPHTHALMIC INSTITUTE AT WIESBADEN.)

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(*With two illustrations in the text.*)

AFFECTIONS of the uveal tract and of the retina after the age of puberty are more rarely observed than parenchymatous keratitis as the first and isolated manifestations of hereditary syphilis; yet they also undoubtedly occur.

At the suggestion of my chief, Prof. H. Pagenstecher, I publish the following hitherto undescribed case, in which hereditary syphilis manifested itself for the first time in a young man of eighteen, who until then had been entirely well, by extensive changes in the veins of both retinas. The case may possess some points of interest for my colleagues.

H. B., æt. 18, presented himself at the Ophthalmic Institute, Feb. 20, 1888. He declared that twelve days ago on rising he suddenly experienced a peculiar sensation of heaviness and pressure in the right eye. He at once closed the left, and discovered to his horror marked obscuration of the previously entirely healthy right eye, the cause of which he did not know. The obscuration, he stated, had decidedly increased during the last few days.

Stat. praes.: R E, V = $\frac{5}{24}$; L E, V = $\frac{5}{5}$; cornea, iris, refractive media of the right eye perfectly normal. The ophthalmoscopic examination in the inverted image shows marked capillary

injection of the OD, with diminution of the transparency, especially at the periphery, which is slightly hazy. In the tissue of the OD there are two delicate streaky hemorrhages along the vena papillaris inferior; the latter is about half as broad again as usual, and of a decidedly dark color. The other vessels of the OD are normal. When the vena papill. inf. is traced beyond the edge of the OD, it is seen to project beyond the level of the retina as a blackish-red cord of double the normal width. The width and dark coloration are greatest about 1 PD from the OD. After division into the v. nasal. and tempor. inf. both these veins, especially the latter, appear broadened and tortuous, even to their most delicate ramifications, and edged in their whole course with fresh, brownish-red hemorrhages, which near the OD present a radiate, streaky appearance, while at the periphery they are of an irregular shape, and often entirely conceal the blood-vessel. The v. nasalis and tempor. sup. show similar conditions, though less marked, so that the whole periphery of the fundus appears covered with fresh hemorrhages. The largest is at the macula lutea, an irregularly oval brownish-red patch of about 1½ PD, with sharp edges, giving rise to a positive, central, incomplete scotoma. The perimeter also shows several smaller peripheral incomplete scotomas, corresponding to the largest hemorrhages. About 1½ PD downward and inward from the macula an evenly thick, white cord, partly covered with hemorrhages, is visible, which joins the curiously tortuous v. tempor. super.

The tissue of the retina between the veins, where there are no hemorrhages, is perfectly transparent. The calibre and walls of the blood-vessels are quite normal.

The only pathological condition in the left eye is a circumscribed change in the wall of the v. nasal. sup., about 2½ PD from the OD. The normal red here shows a slight whitish discoloration, which seems to be formed by the confluence of grayish-white scales, between which reddish dots shine through here and there. The calibre and course of the vein on both sides of this spot are perfectly normal.

The right eye therefore showed the picture of hemorrhagic retinitis, due to a local affection of the blood-vessels, as shown by the changes in the v. temp. super. At the same time I suspected that the slight discoloration in the wall of the v. nasal. sup. of the left eye might be the beginning of a similar affection.

A thorough examination of the powerfully built young man

showed that the other organs, especially the kidneys and heart, the pulse wave, and condition of the blood, were entirely normal. On the penis nothing could be found to indicate syphilis ; infection was positively denied by the patient, whose veracity could not be doubted. There was, however, marked induration of the cervical, cubital, and inguinal glands, so that in view of the changes in the eye the diagnosis of probably hereditary syphilis was made. Questions in this direction, however, were at first unsatisfactory. The patient was at once subjected to inunction (5.0 ungt. hydrarg. pro die).

On Feb. 28th, after thirty-five grms. had been rubbed in, his condition was decidedly worse.

In the right eye there was still V = $\frac{6}{12}$. But the ophthalmoscopic picture more and more approached that of incomplete thrombosis of the central vein. The OD looked "like the head of a Gorgo surrounded with dark locks" (Becker). In every direction the distended black veins rose far beyond the plane of the retina, often surrounded by perfect pools of blood, so that the thought naturally arose that a similar condition had developed in the central vein itself. The hemorrhage at the macula remained unchanged. Judging from the ophthalmoscopic appearances, at least two thirds of the retina were occupied by hemorrhages.

The most marked changes had taken place in the left eye during the week (*cfr.* Fig. 1). Color of the OD more reddish than normal and slightly hazy, especially in the nasal half. Outlines of outer edge indistinct. The slight grayish-white discoloration of the wall of the v. nas. sup. already mentioned had markedly increased. Over a space 1 PD in length the wall of the vein had been converted into an evenly broad, shining, white band ; at a point near the centre the red wall of the vein still shone through. Centrally from this spot, as far as the OD, the vein was very narrow, a mere thread, a sign therefore that the calibre had been decidedly diminished. Peripherally from the white spot on the contrary the vein was distended to twice or three times the normal, and was of a dark-red color. In tracing the ramification of the v. nasal. sup. toward the periphery, two more spots were found, showing similar changes, but not so extensive ; diminution of the calibre centrally from the diseased spots was not apparent. The most peripheral ramifications showed a perfectly cirsoid tortuosity, which could not be reproduced in the drawing, as besides the curves in the plane of the retina there were others rising above

it, as shown by parallactic displacement. All the tortuous parts were filled beyond the normal. At the periphery, as the sketch indicates, there were some irregular, slightly brownish-red venous hemorrhages.

All the other veins, except the v. temp. super., showed similar changes.

The interpretation of the picture was not difficult. An infiltration of round-cells had developed, partly in the perivascular lymph spaces, partly in the wall of the vein itself, which could not be seen more beautifully. With the ophthalmoscope the progressive changes could be observed with almost microscopic accuracy. We saw distinctly how the shining white, band-like changes in the blood-vessels gradually developed from the small whitish spots; from the peripheral swelling, the tortuosity, and the gradually appearing hemorrhages, as well as from the central diminution of the blood-vessel, we could obtain a pretty accurate idea of the permeability of the affected part.

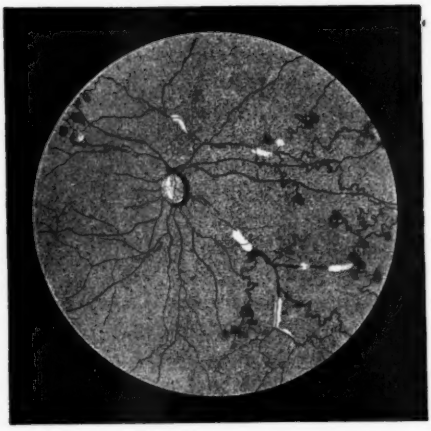


FIG. 1.

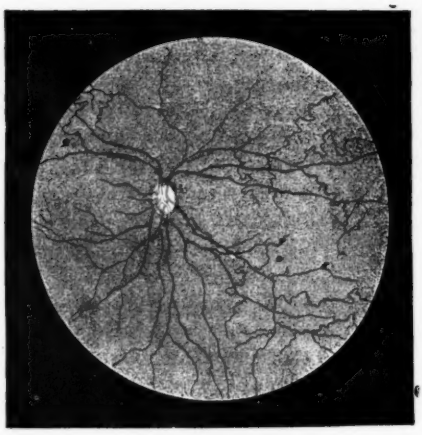


FIG. 2.

I have chosen the sketch made on February 28th for publication, because on that day the affection had reached its height.

The rapid further development of the disease, in spite of the energetic antisyphilitic treatment, might have caused us momentarily to become doubtful as to the correctness of the diagnosis. The father of the patient, however, who now appeared in

answer to our wish, admitted that he had become infected after his marriage, and after his wife had already borne him four healthy children. When the dermic symptoms began to manifest themselves he underwent inunction and was cured. His wife thereupon had two abortions; then the son, the patient under our treatment, was born, and afterwards two more children. The latter are quite healthy. There could now be no more doubt about the correctness of the diagnosis. In spite of the rapid development of the affection, we therefore made a good prognosis, and were not deceived.

New hemorrhages and changes in the walls of the blood-vessels did not take place. As tumultuously as the disease had begun, just as rapidly the changes disappeared. Gradually the whitish discoloration became less and less marked, the red spots shining through became more and more numerous, and the filling of the blood-vessels centrally and peripherally from the affected parts more and more approached the normal. The hemorrhages were gradually absorbed, some after having undergone fatty degeneration. Three weeks later, on March 21st, V in the right eye had risen to $\frac{6}{18}$, on March 30th to $\frac{6}{12}$. In the left, normal sight had always been preserved. On April 8th, after 200 grms. of ungt. hyd. had been used, the patient was discharged from the hospital. R, V = $\frac{6}{9}$; L, = $\frac{6}{6}$.

Six months later, on October 13, 1888, the patient was seen again. V was the same. In the right eye there were still very thin remnants of hemorrhages, about $\frac{1}{4}$ PD in diameter, with delicate changes in the pigment at the macula, and a small whitish discoloration of the retina beside the v. temp. sup. for a distance of about $\frac{1}{3}$ PD; the calibre known was again normal. All the other hemorrhages had been completely absorbed. Here and there some patches of the pigment the size of a pinhead still remained at the periphery. The tortuosity of the peripheral veins, however, was the same as before, but the filling was not abnormal.

The condition of the left eye is shown in Fig. 2. Small pigment patches are the only evidences of the former hemorrhages. At the spot first infiltrated there is a delicate, grayish-white discoloration beside the once more normal v. nasal. sup. There are no other perivascular changes. As in the other eye the cirsoid tortuosity of the terminal veins has remained. But the calibre of the blood-vessels is normal with the exception of the endings of the v. nasal. infer., which shows besides greater tortuosity also

greater filling with blood. Following this vein farther, three smaller veins are seen to join it; from the manner of the junction it becomes apparent that the direction of the flow was formerly different. Now, however, the ending of the vein cannot be traced farther; it disappears. Evidently the plaque had closed the calibre of the v. nasal. sup. at this point, and a collateral anastomosis with the v. nasal. inf. had been formed, an observation which has been made at various times with the ophthalmoscope.

On March 23, 1890, two years later, I examined the patient for the last time. R E, V=$\frac{6}{6}$; L, the same. In the right eye the hemorrhage at the macula had been completely absorbed. In the upright image about $\frac{1}{2}$ PD upward and inward from the macula a roundish spot the size of a pinhead is seen, of a brighter rosy-red color than the remainder of the retina, with a delicate darker edge, the only trace of the hemorrhage. Otherwise the condition is the same as on October 13, 1888. The veins in particular show the same cirsoid tortuosity at the periphery, their calibre being normal.

This latter condition also prevails in the left eye. The anastomosis has remained, and the three small veins discharge their blood into the v. nasal. infer. That part of the v. nasal super. which had been obstructed by the plaque had become so atrophic that it could not be found with the ophthalmoscope. The perivascular changes have completely disappeared.

In conclusion let me briefly sum up the peculiarities of the case. Congenital syphilis first manifested itself in a a strong, young blacksmith of eighteen in the form of perivasculitis of the retina of both eyes, attacking only the veins with the exception of the left v. tempor. super., leading to the partial occlusion of the calibre of the vessels, enormous dilatation, and very peculiar tortuosity of the terminal veins, and extensive hemorrhages, and quickly healing after inunction. The hemorrhages and perivascular patches are rapidly absorbed, only the curious tortuosity of the veins remains, but their calibre is normal. In the left eye an anastomosis develops between the vv. nasal. super. and infer., the result of occlusion of the blood-vessels by a pigmented plaque arising from a hemorrhage. Two years later the condition is practically the same.

From its first appearance to complete recovery the disease was observed with the ophthalmoscope.

Explanatory remarks as to the nature of the pathological changes are unnecessary, for since the publications of the articles of Michel[1] and Angelucci[2] on the spontaneous thrombosis of the central retinal vein peri- and endovasculitis have received general attention. As already mentioned and as shown by the case of phlebitis ophthalmica observed by Schmidt-Rimpler,[3] we had to deal with an infiltration of round-cells into the perivascular lymph spaces and into the walls themselves of the blood-vessels. Secondarily thrombosis and hemorrhages may result.

As early as 1878 Hutchinson[4] expressed the opinion that in a number of cases of hemorrhagic retinitis venous thrombosis might be the cause. Angelucci in many cases attributes the thrombosis to primary changes in the walls of the blood-vessels. In 1881 Schubert[5] publishes a case of hemorrhagic retinitis, which he also attributes to venous thrombosis.

Perivasculitis of the retinal arteries has been seen and described in a number of cases. Fürstner[6] has published such a case, which Becker observed with the ophthalmoscope, in which there was arteriitis obliterans of the vertebral, basilar, and ophthalmic arteries with slight implication of the ciliary and retinal arteries. The existence of syphilis could not be established. In the case described by Hirschberg,[7] however, syphilis was the cause, and Haab[8] also observed and published a case of syphilitic arteriitis.

I am greatly indebted to Professor Pagenstecher for his suggestions and kind assistance.

[1] 1878. Die spontane Thrombose der Vena centr. des Opticus, *Graefe's Archiv*, vol. xxiv., 2, p. 37.
[2] 1878. Thrombose der Vena centr. retinae, *Klin. Monatsbl. f. Augenheilk.*, p. 443.
[3] 1877. Phlebitis ophthalmica, *Graefe's Archiv*, p. 229.
[4] 1878. *Med. Times and Gazette*, vol. i., p. 104.
[5] 1881. Zur Casuistik der Retinitis syphil., *Centralbl. f. prakt. Augenheilk.*
[6] 1883. *Deutsche Zeitschr. f. klin. Med.*, vol. xxx., p. 534.
[7] 1883. *Centralbl. f. prakt. Augenheilk.*
[8] 1886. *Schweizer Correspondenzbl.*, No. 6, p. 152.

A CASE OF UNIOCULAR ZONULAR CATARACT.

By F. E. D'OENCH, M.D.

About five years ago, Louis S., æt. eight, was brought to the Dispensary of the New York Ophthalmic and Aural Institute on account of defective vision of his left eye, which only lately had been discovered. No complaint was made in regard to the right, except that the boy in reading was obliged to hold the book quite near the eye.

The cause of the poor sight of the left eye was found to be due to a zonular cataract, the diameter of the opaque zone being about 3‴, and showing an irregular whitish thickening at the anterior pole. The remainder of the lens was clear, V = $\frac{1}{\infty}$. The other eye showed no changes whatever, the lens in particular being perfectly clear. The child had never had convulsions, and his teeth were good, without any notches.

An iridectomy downward and inward was performed by Dr. Knapp, after which vision rose to $\frac{8}{200}$.

The boy was then lost sight of, and I did not see him again until five years later, when he came back to have his right eye fitted with glasses. There has apparently been no change in the zonular cataract, but vision has diminished, being only $\frac{8}{200}$, which with — 11 D^c ax 65°n could be raised to $\frac{4}{200}$. The lens is of normal size, and its edge can be distinctly seen at the periphery of the coloboma.

The vision of the right eye is $\frac{15}{200}$, which with — 4 D⌒ — 4 D^c ax 70°n can be raised to $\frac{20}{20}$ +; with — 4 D^c ax 70°n he can read J 1 at about 9″, and these two glasses were prescribed for him, the left receiving only a plane glass.

The absence of convulsions, and of any change in the cataract for five years, make it very probable that the condition is a congenital one.

A BLACK SPOT AT THE MACULA LUTEA IN A CASE OF EMBOLISM OF THE ARTERIA CENTRALIS RETINÆ.

By Dr. T. INOUYE, Tokio, Japan.

Myjabe, a girl, æt. seven, consulted me October 19, 1890, with the following history.

Three years previously she had suffered from blennorrhœa which had caused blindness in the left eye. At the same time she became emaciated, and exhibited a morbid appetite, devouring greedily mud, linen, etc.

October 17th, on rising in the morning she found that she was completely blind, the right eye also having become affected. The patient felt well in other respects, and there was no heart lesion. In the right eye all perception of light was lost, but the exterior of the eye appeared normal. With the ophthalmoscope it was at once noticed that the usual transparence of the retina was wanting. In consequence of this the pale optic disc was not sharply outlined. The arteries and veins were not clearly distinguishable, and it was difficult or almost impossible to say which were the arteries and which the veins. All the veins were narrow and thread-like, showing in the middle a barely perceptible light-reflex. The arterial current was interrupted and slow. Between the separate blood-cylinders the vessel tube appeared as a bright thread-like line. At the macula lutea a small coal-black spot was seen in place of the usual cherry-red one, so well known in embolism.

This color interested me, since in the Japanese I had never before found the spot black, but always red. The Japanese are strongly pigmented, and it is probable that the black choroid shone through the thin fovea centralis, although the child was not unusually dark.

I have found no case similar to this in literature, and I am curious to know whether in cases of embolism in the negro the macula lutea appears black or has its usual cherry color.

A CASE OF LENTI-CONUS POSTERIOR, WITH REMARKS.

By JOHN E. WEEKS, M.D.,

SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY.

M. L., age seven years. Has had convergent strabismus of the left eye since she was an infant. The patient was brought to my clinic at the New York Eye and Ear Infirmary on February 28, 1891, for the purpose of having the squint corrected. On examination the following conditions were found :

Right eye.—From the line between the greater and minor zones of the iris two small filaments project, extending into the pupil. Remnants of the fœtal pupillary membrane. In other respects the eye is perfectly normal. $V = \frac{20}{20}$.

Left eye.—Size normal ; pupil central, of normal size, reacts well to light. On looking into the eye with the ophthalmoscope, using the mirror only, a bright circular patch, apparently about 4 *mm* in diameter is seen, located between the iris and the fundus in the antero-posterior axis of the globe. About the margins of this disc light and dark crescentric figures play on changes in the direction of the light. When viewing the interior at about twelve inches from the eye, images of the vessels of the fundus are seen which on movements of the observer's head appear to go with or against it according as the vessels are seen through the periphery or through the centre of the lens. Hence at the centre of the lens the eye is myopic, while at the periphery of the lens it is hypermetropic.

If while holding the mirror in one position the cornea is made to move in various directions, the disc is seen to move, and, when compared to the position of the corneal reflex (which is always referred, by the observer, to the centre of curvature of that part of the surface of the cornea from which it is seen—in normal

corneæ to a point approximately 7.8 *mm* from the surface), the disc moves with the cornea (apparently against the reflex), the periphery of the disc describing a larger arc than the centre, in fact the centre or apex of this body corresponds almost exactly with the centre of curvature of the cornea. It follows that this mass projects beyond the normal curvature of the lens, and since the posterior surface of the lens is normally about 7.2 *mm* from the surface of the cornea, 0.6 *mm* less than the length of the radius of the cornea, it has an antero-posterior diameter of about 0.5 *mm*. Its base is probably about 2.5 *mm* in diameter. The condition is known as lenti-conus or cristallo-conus posterior. At the apex of the cone there is a small opacity which may be, and from its flattened form most probably is, a remnant of fœtal blood-vessels. In all other respects the interior of the eye is normal. Vision $= \frac{1}{100}$; not improved with glasses. At the periphery of the lens the refraction is hyperopic 3.5 D, at the centre myopic about 12 D. The strabismus measures twenty-six degrees. The excursions of the eye are normal in extent.

Cases of lenti-conus are very rare, four only having been reported. The first is by Webster (*Arch. of Ophthal.*, 1875), and is one of binocular lenti-conus anterior. It occurred in a male of twenty-four years. The vision in either eye was $\frac{15}{100}$ increased to $\frac{30}{100}$ with glasses. Illumination with the ophthalmoscopic mirror gave the appearance of kerato-conus. At a distance of twelve inches two images of retinal vessels could be seen, one in the centre of the pupillary reflex and one at the periphery. On movement of the observer's head from side to side the images were seen to move in opposite directions. Examination by oblique illumination revealed a conical protrusion of the centre of the anterior part of each lens into the anterior chamber. The whole surface of the posterior capsule was dotted over with minute opacities, and there was small posterior polar cataract.

The second case is reported by Van der Laan and Placido. (*Period. de Ophthal. Lissboã*, 1881).

As I have not succeeded in obtaining the original article, I cannot do better than to refer to the abstracts contained in these ARCHIVES, vol. x., p. 497, and in *Nagel's Jahresbericht*, 1880, p. 369.

The case was one of lenti-conus anterior occurring in a man of 23 years. Whether one or both eyes were affected is not stated. The myopia at the apex of the cone was of a high degree, at the periphery of the lens the refraction was hypermetropic three (3) dioptries; a history of gradual development during a period of eight years was given.

The first case of lenti-conus posterior was reported by F. Meyer (*Hirschberg's Centralbl f. p. Augenhl.* Bd. xii., p. 41), and occurred in a boy of ten years. For three or four years the father had noticed that the right eye turned outward. When seen there was moderate divergent strabismus of the right eye. Vision = $\frac{15}{200}$, not much improved with glasses. Left eye, vision = $\frac{20}{20}$; Em. On looking into the right eye with the plane mirror of the ophthalmoscope, a circular spot was seen in the centre of the pupil, circumscribed by light and dark rings, which would change their position on a change in the direction of the light. At the apex of the cone there was a sharply defined opacity, and a number of small opacities were present on the posterior capsule near the posterior pole. These spots appeared white by oblique illumination. At the periphery of the lens the refraction was emmetropic, at the centre myopic 13 D. The eye was normal in size.

The second case of lenti-conus posterior is reported by Dr. H. Knapp (these ARCHIVES, vol. xviii., p. 453), and occurred in a girl of eight years. The left eye was normal in every respect. There was binocular fixation when regarding objects attentively, but soon the right eye would swing 3 or 4 *mm* outward. Vision = $\frac{15}{200}$ with — 12 D $\frac{20}{200}$. Fundus normal. "With a plane mirror a sharply defined red disc, of an apparent diameter of 4 *mm*, is seen in the centre of the red pupil, surrounded by dark shadows. It resembles an oil globule on water." In relation to the corneal reflex, the disc moves with the cornea on movements of the eye. A double set of vessels may be seen moving in opposite directions on movements of the observer's head. There is no opacity in lens or capsule. The eye is normal in size.

The manner in which lenti-conus is produced is as yet obscure. Prof. O. Becker ("Anatomie d. gesunden u. kran-

ken Linse," 1883, p. 126) has made a very interesting report of the examination of specimens of lenti-conus posterior from the eyes of a rabbit sent to him by Schöler and Uhthoff, of Berlin. Although the sections obtained were not as perfect as was desired, Becker was able to determine that the concentric lens fibres, products of the third period of lens development, did not come together at the posterior pole, but that they butted on to, or formed around, the elongated nuclear fibres of the second period of lens development, these latter extending beyond the concentric laminæ and forming the cone.

It may readily be conceived that traction on the anterior or posterior parts of the lens in early fœtal life might produce this condition. In lenti-conus anterior it would only be necessary to infer that the lens had become unusually adherent to the posterior surface of the cornea in its early embryonic stage, and that in the formation of the anterior chamber some traction had been exerted. In the cases observed no mention is made of any irregularities in cornea or lens that could be construed as facts in favor of this supposition. In lenti-conus posterior the conditions are somewhat different. In my own case and in the case described by Meyer, there was evidence of the unusual persistence of fœtal tissue in the presence of opacities on the posterior lens capsule. Opacities in each case were situated at the apex of the cone, and may have been the site of attachment of fœtal vessels which, by producing traction on the forming nuclear fibres of the lens, had caused them to become unusually elongated. Lenti-conus is probably always congenital.

ON THE USE OF PLATINUM INSTRUMENTS IN OPHTHALMIC SURGERY.

By Dr. E. GRUENING, New York.

IN bacteriological technique metallic instruments, notably platinum needles, are heated to a glow and thus sterilized. This ideal depuration cannot be practised in general surgery, inasmuch as both the bulk and the material of the instruments forbid a similar treatment. In ophthalmic surgery, however, where the instruments are comparatively small, the intractable steel may be replaced by the more easily managed platinum.

Messrs. Tiemann & Co., made for me a set of platinum eye-instruments which have been in use almost one year. The set contains a cystitome, an iris repositor, a wire loop, a spoon, several straight and curved iris forceps, a fixation forceps, and a speculum. The working parts of these instruments consist of an alloy of platinum and iridium. The platinum, thus alloyed and compressed by hammering, becomes very firm, and when polished is not blackened by the flame of a spirit lamp.

Incomplete as the set is (it contains neither knives nor scissors), it stood me in good stead, and to-day I should not like to perform an operation for the extraction of cataract without the aid of these instruments.

The time required for the sterilization of a platinum instrument by imparting to it a white heat is but a small fraction of a minute, so that every instrument required for an operation can be prepared in a direct, simple, and thorough manner by the surgeon. This feature, which renders

the operator independent of an assistant in the sterilization of the instruments, is of special importance.

When we consider that the structures of the eye, notably the cornea and the vitreous body, furnish a favorable nutrient soil for the development of micro-organisms, and that the introduction of these into the eye is in many instances tantamount to its destruction, it becomes evident that the use of platinum instruments is not an unnecessary refinement.

It may be argued that suppuration after operations upon the eye is rare at the present time, and that the statistical records of skilled operators show but a small percentage of loss from either primary or secondary infection.

All this is conceded, but I hold that our statistics should be improved still further, so that our future records might show no loss from suppuration and a much less frequent occurrence of non-suppurative inflammations, such as iritis, irido-cyclitis, and capsulitis.

I believe that the more general use of platinum instruments may aid in insuring such grateful results—"a consummation devoutly to be wished."

PRISM MEASURE OR LENS CENTERING INSTRUMENT.[1]

By A. L. SMITH, Pres. Geneva Optical Company.

WE illustrate herewith a new device for the use of opticians and oculists for the purpose of centering lenses and also for measuring the degree of a prism, or prisms in lenses combined with spherical or cylindrical sur-

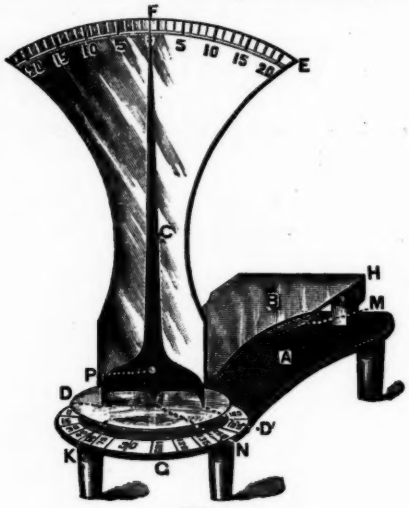


FIG. I.

[1] Mr. Smith, who designed the instrument himself, was kind enough to send me a sample of it with the above communication. On examining and testing it, I find that it answers its purpose in every respect. Like the lens measure, it will prove a valuable aid in the daily work of the oculist. While thanking and congratulating the Gen. Opt. Co., I cannot refrain from expressing my pleasure at seeing that the spirit of enterprise and ingenuity, for which American industry is so famous, has become fully alive also in the department of opthalmological optics. H. Knapp.

faces. The instrument is so simple in its action that a description is hardly necessary. The illustrations will make plain to any oculist or optician the entire practicability and range of its work. It will give instantly the amount of prism in any lens, and the value of such an instrument will be appreciated by the trade and profession, as it is one of the most difficult and annoying parts of the business to analyze a lens and give the amount of prism, especially when combined with convex or concave surfaces. Its action will be readily understood from the following description.

FIG. 2.

The first illustration gives the instrument as used for centering lenses. The instrument consists of a bed plate *A*, upon the front of which is affixed a degree circle *G*, and hinged to *A* at *H* is the upper plate *B* thrown up by a spring *M* not shown plainly because it is under *B*. The upright face plate *C* stands at right angles to *B*. On the top of *C* is the degree circle *E*. The index finger *F* with lower part *D D'* is made of steel and pivoted at *P* to swing easily over any portion of the dial plate. In using, the lens *K* is placed upon the lower points that cannot be shown, as they

are covered by the lens. The upper plate *B* is pressed down until the points *D D'* touch the lens, and if the lens is of the same thickness at *D* as at *D'* the index finger *F* will point to *O* on the scale *E* and the point *N* will be exactly over the centre of the lens.

The second illustration shows the same instrument measuring a prism, and the position of the index finger *F* will be governed by the difference of the thickness of the lens at the points *D D'* and the degree of the prism will be indicated on scale *E* by the pointer *F*. The operation is quick and exact, and the value of the instrument at the present time, when so much attention is being given to the correctly placing the centre of the lens or adding prism to correct for muscular defect, makes this an invaluable instrument for the oculist or optician. Handsomely made in nickel with steel pointer. It is manufactured and patented by the Geneva Optical Co., 23 Washington St., Chicago, and the price is $5.

SPONTANEOUS CURE OF PROLAPSE OF IRIS AFTER CATARACT EXTRACTION.

By Dr. E. LOPEZ, of Havana, Cuba.

I USUALLY operate for cataract by simple extraction with superior keratotomy. One of the most disagreeable complications of this method is the occurrence of prolapse of iris. The usual treatment of these prolapses with myotics, has, as a rule, no effect. In these cases the excision of the prolapsed portion seems to be rational. Nevertheless there are a few cases, similar to those which I am about to describe, in which it would seem proper to temporize a little with this complication, as the prolapse may disappear without surgical interference.

1st Case.—Woman; fifty years of age; simple extraction (R. E.); no accident; eserine (1%); compressive bandage over both eyes.

5th day.—Good condition; apparently a firm scar; pupil large, somewhat elongated upwards, pyriform.

7th day.—Conjunctival injection; prolapse of iris at the centre of the section; the prolapse is small; eserine.

12th day.—The iris has re-entered the anterior chamber, remaining attached to the scar at its base, leaving a slightly oval pupil.

2d Case.—Woman; fifty-eight years of age; simple extraction (R. E.); no accident; eserine (1%); round pupil; both eyes bandaged.

4th day.—Small prolapse of iris; pain in the right temple; atropine ($\frac{0.02}{10.00}$).

15th day.—The prolapse has disappeared, leaving only the base of the iris attached to the internal surface of the scar. The pupil is slightly distorted and partly obstructed by secondary opacities.

In these cases the spontaneous cure of these small prolapses is proven. This can in nowise be attributed to the treatment, for although in the first case myotics were employed, in the second mydriatics were made necessary by the incipient iritis.

SUPPLEMENT TO DR. GEO. LINDSAY JOHNSON'S PAPER: A NEW TREATMENT OF CHRONIC TRACHOMA.

PUBLISHED IN THE PREVIOUS VOLUME OF THESE ARCHIVES (XIX., P. 264).

(*With plate ii. of vol. xix.*)

DR. JOHNSON illustrated his article by two chromolithographs on Tab. II., which ought to have been issued with his paper. They are appended to the present number, and we beg our readers to make a note of it in their copies. The explanation of the plates is as follows:

The two drawings present the right and left upper eyelid of a ten-year-old girl. Both lids were in the same condition, affected in the same manner with follicular trachoma. The operation described in the paper was performed on the left eye (Fig. 2). Six weeks later both eyes were drawn (Figs. 1 and 2). The white horizontal stripes (Fig. 2) represent tracts of cicatricial tissue caused by the wounds from the action of the sillonneur. The immediate union of these wounds had been prevented by the electrolysic destruction brought about by the platina plates.[1]

[1] The editor takes pleasure in stating that last summer he had the privilege of seeing Dr. Johnson operate on two cases, and to witness the highly satisfactory recovery of others which had been operated on by the doctor, according to his method.

H. K.

SYSTEMATIC REPORT ON THE PROGRESS OF OPHTHALMOLOGY DURING THE FIRST HALF OF THE YEAR 1890.

By H. MAGNUS, Breslau; C. HORSTMANN, and P. SILEX, Berlin.

WITH THE CO-OPERATION OF

S. M. Burnett, Washington; Dantone, Rome; Hirschmann, Charkow; E. Marckwort, Antwerp; P. v. Mittelstädt, Metz; L. Werner, Dublin; C. H. A. Westhoff, Amsterdam; Schiötz and Ole Bull, Christiania, etc.

(Continued and concluded from p. 159 of this volume.)

XI.—CONJUNCTIVA, CORNEA, SCLERA, ANTERIOR CHAMBER.

103. Burchardt, M. Gonorrhoic ophthalmia, especially its treatment. *Deutsche militärärztl. Zeitschr.*, vol. xix., 8, p. 592.

104. Deutschmann, R. Arthritis blennorrhoica. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 1, p. 109.

105. Franke, E. The transplantation of skin and mucous membrane. *Centralbl. f. prakt. Augenhk.*, 1890, p. 161.

106. Germann, Th. The etiology of trachoma. *St. Petersburger med. Wochenschr.*, 1890, No. 29.

107. Kipp, C. J. Further observations on malarial keratitis. *Trans. Amer. Ophth. Soc.*, 1889.

108. Krause, P. The history of trachoma since the wars of Napoleon to the end of the year 1889. *Inaug. Diss.*, Berlin, 1890.

109. Lippincott, J. A. Irrigation of the anterior chamber—a new syringe for effecting it. *Trans. Amer. Ophth. Soc.*, 1889.

110. Noiszewski, K. Plastic conjunctivitis—a radical method of curing chronic trachoma. *Centralbl. f. prakt. Augenheilk.*, 1890, p. 36, No. 234; *Wratsch*, 1890, No. 29.

111. Rosmini. Sull' uso del sublimato corrosivo nella terapia oculare e specialemente nella cura dell' oftalmia granulo-tracomatosa. *Boll. d'ocul.*, vol. xii., Nos. 7, 9, and 11.

112. Schmidt-Rimpler, H. Remarks on the etiology and treatment of blennorrhœa neonatorum. *Deutsche med. Wochenschr.*, 1890, No. 31.

113. Shongolowicz, D. The question of the micro-organism of trachoma. *St. Petersburger med. Wochenschr.*, 1890, Nos. 28 to 30.

114. Valenta, A. Contribution to the prevention of ophthalmo-blennorrhœa neonatorum. *Wiener klin. Wochenshr.*, 1890, No. 35.

In gonorrhoic conjunctivitis Burchardt (103) thoroughly washes out the conjunctival sac with a salicylic solution (1.5:1000), and then with a solution of nitrate of silver (1:600). He also instils a weak solution of nitrate of silver every two hours.

Deutschmann (104) observed acute inflammation of the knee-joint in a child, three weeks after a genuine blennorrhoic conjunctivitis. Both the conjunctival discharge and the liquid obtained by puncture from the knee-joint contained typical diplococci. Microscopic examination of a piece of conjunctiva showed gonococci upon and between the epithelial cells, and in the subepithelial tissue enclosed in pus-cells, close to the walls of the delicate loops of blood-vessels extending to this point. The cocci probably enter the blood- and lymph-vessels at this point and infect those tissues which react especially to their presence.

Franke (105) cured a case of trichiasis by transplantation of a piece of skin from the upper arm.

Germann (106) observed in three cases the development of trachoma after some black earth had entered the conjunctival sac. He therefore thinks that dirt and dust contain the micro-organisms producing trachoma. The intensity of the inflammation and the length of the stage of incubation seem to depend upon the quantity of germs introduced.

Since Kipp (107) first reported on malarial keratitis in 1880 he has studied 120 additional cases. He finds that fully 90% were affected with malarial fever. He has, however, seen the

peculiar dendritic ulceration in persons who were perfectly healthy. He has tried scraping the ulcers, and scraping with application of nitrate of silver, in some cases with benefit. He attaches most importance to general treatment of the malarial poisoning. BURNETT.

LIPPINCOTT (109) has used irrigation of the anterior chamber in fifteen cases of cataract-extraction and had satisfactory results. His instrument consists essentially of a rubber tube with a fine gold nozzle attached to it, with a holder and a sort of valve, which regulates the flow of the water from a reservoir placed above, and in which the other end of the tube is placed. He uses any aseptic fluid, a strong antiseptic not being desirable. BURNETT.

In trachoma NOISZEWSKI (110) excised the retrotarsal fold and the affected part of the conjunctiva, and implanted a piece of mucous membrane taken from the lip. He recommends this method in all cases of old trachoma; it should not be resorted to when the ordinary methods of treatment are sufficient.

ROSMINI (111) is very enthusiastic over the action of sublimate in follicular and trachomatous conjunctivitis, and applies it in a solution of 1:1000 (sometimes also weaker) with an irrigator to the affected mucous membrane for thirty to sixty seconds and longer. He lays great stress upon this method of application. DANTONE.

SCHMIDT-RIMPLER (112) calls attention to the fact that frequently cases of blennorrhœa neonatorum are observed in which no gonococci are found in the discharge, and the course is, nevertheless, a severe one. He therefore recommends the prophylactic treatment of the eyes of the new-born whenever there is fluor, even if not of a gonorrhoic nature. Simple ablution with water is not sufficient; antiseptic instillation into the eyes affords greater security. To avoid irritation he uses the officinal aqua chlori, the disinfecting action of which is very great. It is well borne by the conjunctiva.

SHONGOLOWICZ (113) examined the contents of the follicles of 26 patients with well-developed trachoma, and also in 12 of them the retrotarsal folds. He found in all cases in the contents of the trachoma follicle among the micro-organisms present particularly short rods, remarkable on account of their small size and the difficulty of staining them with aniline colors; all parts of the rods were not stained with equal intensity and the refraction in the

different parts varied; the same short rods were found in sections of the fornix of trachomatous conjunctiva, while other micro-organisms were absent. Sometimes an affection similar to trachoma could be produced upon the conjunctiva of cats and rabbits by inoculation with pure cultures.

VALENTA (114) uses a weak solution of permanganate of potassium.

115. BETTREMIEUX. Considérations sur le traitement de la cornée à hypopyon. *Soc. franç. d'opht.*, May 6, 1890.

116. BRAUNSCHWEIG. A contribution to the knowledge of pyoktanin. *Fortschritte d. Med.*, 1890, No. 11.

117. CZERMAK, W. On vesicular cavities and their relation to corneal fistula. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 2, p. 163.

118. GALEZOWSKI. De l'epithélioma cornéen et son traitement. *Soc. d'opht. de Paris*, Jan. 7, 1890.

119. GALEZOWSKI. Epithélioma de la cornée. *Progr. méd.*, 1890, No. 4.

120. HIRSCHBERGER. On corneal affections in influenza. *Münchener med. Wochenschr.*, 1890, No. 4.

121. LANG and WOOD. An examination of the patellar tendon-reflex in 62 cases of interstitial keratitis. *Royal London Ophth. Hosp. Rep.*, vol. xii., p. 312.

122. LAWFORD, J. B. Remarks on keratitis punctata or descemetitis. *Royal London Ophth. Hosp. Rep.*, vol. xii., p. 298.

123. PERA. Contributo alla cura delle ulceri della cornea. *Boll. d'ocul.*, vol. xii., 10–11.

124. PFISTER, J. One hundred and thirty cases of keratitis interstitialis diffusa, including five cases of keratitis interstitialis annularis according to Vossius. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxviii., p. 114.

125. SCHEFFELS, O. On the treatment of corneal ulcers with pyoktanin. *Berliner klin. Wochenschr.*, 1890, No. 28.

126. STILLING, J. Aniline dyes as antiseptics and their application in practice. Strassburg, 1890.

127. TAYLOR, C. B. On the importance of securing coaptation of the lids in certain diseases of the eye. *The Lancet*, Feb., 1890, p. 293.

128. WERJINSKI, A. Diffuse parenchymatous inflammation of the cornea. *Medic. Obosernje*, 1890, vol xxviii., No. 9.

According to BETTREMIEUX (115) it frequently happens in corneal ulcer with hypopyon that the suppuration spreads in spite of antiseptics and Saemisch's incision. In such cases an iridectomy proves useful. According to Dufour this has long been known. MARCKWORT.

BRAUNSCHWEIG (116) from his experience warns against the use of pyoktanin, as in several cases it did direct harm. SCHEFFELS (125) also had only negative results in corneal ulcers. He considers the treatment with pyoktanin harmful, because time is lost which might have been better employed by dividing or cauterizing the ulcer.

CZERMAK (117) describes four cases in which vesicular cavities had developed in corneal scars. In all of them they were the result of perforating ulcers. The condition of the outer surface was favorable to bursting, and a canal discharging the aqueous externally was found. For details see the original.

GALEZOWSKI (118) discusses epithelioma of the cornea, and on the basis of a reported case recommends the application of the galvano-cautery to the wound and its surroundings after the removal of the tumor. Dubois de Lavigerie used lapis infernalis instead of the galvano-cautery, and had no relapse. Chibret prefers the thermo-cautery for this purpose on account of its more energetic action. MARCKWORT.

In the 62 cases examined by LANG and WOOD (121) hereditary syphilis existed in 69 %, and struma in about 11 %. In 30 % of the cases the patellar reflex was subnormal, and entirely absent in 10 %. WERNER.

LAWFORD (122) believes that the cells in the deposits of keratitis punctata are migratory cells, and that the underlying cells of Descemet's membrane become indistinct and swollen.

WERNER.

PERA (123) reports a case of corneal ulcers of both eyes due to trachoma, in which even the weakest solutions of sublimate (1 : 5000 and 1 : 7000) were not tolerated, and only caused pain and increased irritation. He therefore concludes that sublimate should only be used in extensive ulcers at an advanced stage of repair. DANTONE.

PFISTER (124) found that among 130 cases of keratitis punctata the affection occurred in both eyes in 69.2 %. Hereditary syphilis undoubtedly existed in 40 %, probably in 23.8 %, acquired syphilis in 2.3 %, probably acquired syphilis in 1.5 %. Hutchinson teeth

were observed in 23.8 %, choroiditis disseminata was found in 6.9 %, serous iritis in 13 %, and plastic iritis in 6.9 %.

STILLING (126) recommends methyl-violet in corneal ulcers and hypopyon-keratitis, as it is a powerful antiseptic. He also advises its application in keratitis parenchymatosa, serous iritis, old cases of disseminate choroiditis, and in syphilitic ophthalmia. He used the remedy in solution, and in form of a powder, salve, and pencil.

TAYLOR (127) in a case of corneal ulceration from Basedow's disease, united the lids, leaving a central slit-like portion free.

WERNER.

129. MÜLLER. Case of tuberculosis of the sclera. *Wiener med. Blätter*, 1890, No. 12.

130. ROLLAND. Extraction d'un tumeur mélanotique intra-oculaire par une incision de la sclérotique. *Rec. d'opht.*, 1890, p. 25.

In MÜLLER's (129) case there was a cystic tumor upon the sclera, which had been mistaken for a cysticercus and removed. It proved however to be a conglomeration of miliary tubercles.

ROLLAND (130) found in a man aged 32, upon the upper inner part of the eye, 6 *mm* from the corneal margin, a tumor the size of a bean upon the outer surface of the sclera, and at the same spot within the eye another the size of a fly's head. Vision was normal. The two tumors were removed together with the small piece of sclera separating them. The opening in the sclera was closed with a catgut suture, and that in the conjunctiva with three silk sutures. The clinical diagnosis of melanosarcoma was verified by the microscopical examination. Seven months after the operation the family physician reported to Rolland that the patient "enjoyed perfect vision and health."

MARCKWORT.

Sections XII.—XXI. Reviewed by DR. P. SILEX.

XII.—IRIS.

131. BURCHARD. Presentation of a case of paradoxical pupillary reaction. *Berliner klin. Wochenschr.*, 1890, p. 40.

132. GUTTMANN, G. A case of tuberculosis of the eye. *Berliner med. Gesellsch.*, March 26, 1890. *Deutsche med. Ztg.*, 1890, No. 25.

133. LANG, W. The division of anterior synechiæ. *Royal London Ophth. Hosp. Rep.*, vol. xii., p. 356.

134. PANAS. La tuberculose de l'œil. *Progr. méd.*, 1889, No. 46, p. 465. (Recommends the internal exhibition of iodoform [0. 4 daily] in tuberculous iritis.)

135. TERSON (de Toulouse). Tuberculose oculaire, excision d'un tubercule de l'iris suivie de succès. *Arch. d'opht.*, vol. x., 1, p. 7.

136. WAGENMANN, A. On pseudo-tuberculous inflammations of the conjunctiva and iris from caterpillar hairs. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 1, p. 126.

137. WILLIAMS, H. W. Multiple cysts of the iris in both eyes. *Trans. Amer. Ophth. Soc.*, 1889.

On BURCHARD'S (131) patient iridectomy had been performed on account of total adhesion. When light was thrown into the eye the pupil dilated, and contracted when it was shaded. Burchard explains it by saying that the sphincter, which had been completely divided below, contracted upon illumination; but, being firmly adherent above, it drew the three edges apart, thereby dilating the pupil.

In GUTTMANN'S (132) case, a child six months old with hereditary syphilis, there was a large tuberculous tumor upon the iris of the right eye, and near it very small miliary nodules. In the left eye there was tuberculosis of the choroid.

LANG (133) makes a corneal puncture with a Knapp discission knife, which is withdrawn, and the synechiæ are then divided with a similar but blunt-pointed knife passed through the puncture.

WERNER.

TERSON (135) observed in an otherwise healthy one-year-old child the development of an iris-tubercle, which first appeared as a yellowish-white nodule the size of a pinhead at the periphery of the iris, with marked injection of the neighboring sclera, and the appearances of serous iritis. Four months later, when the tumor had grown into the anterior chamber, the author made a large peripheric flap-section with a Graefe knife, drew the nodule out, and cut it off, a little vitreous escaping. The tumor had probably united with the ciliary body, and the zonula had been torn and the lens dislocated. The tumor had the shape and size of a large pea. Healing progressed slowly but favorably. $V = \frac{1}{6}$; ophthalmoscopic condition not noted. Inoculation with the tuberculous mass and microscopic examination confirmed the diagnosis. The author thinks that as soon as the tumor appears in the anterior chamber it should be excised, except when the

tumor springs from the periphery, when it is advisable to wait awhile, in order to avoid the danger of breaking up the tumor, which here is only accessible with difficulty, and thereby producing new sources of infection. He is opposed to enucleation, as it does not prevent general infection with certainty.

V. MITTELSTÄDT.

WAGENMANN (136) adds to the number of these cases as reported by Pagenstecher and Weiss.

WILLIAMS' (137) case was a girl of nine years, in whom there was a large single cyst and two smaller ones in the right, and two somewhat convoluted cysts extending into the pupillary space above and below in the left eye. Very little vision, and a good view of the fundus could not be obtained. Patient seen but once.

BURNETT.

XIII.—CHOROID.

138. DUCAMP. Un cas de sarcome ossifiant de la choroide. *Montpellier méd.*, 1889, p. 533.

139. EWING, E. Metastatic carcinoma of the choroid, the ciliary body, and the iris. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 1, p. 121.

140. NOYES, H. D. Enucleation during panophthalmitis suppurativa—what is the danger to life and how to obviate it? *Trans. Amer. Ophth. Soc.*, 1889.

NOYES (140) reports a case of enucleation after panophthalmitis had supervened and where there were symptoms pointing to serious brain implication. He made numerous and deep incisions into the orbital tissues, letting out pus and blood; antiseptic injections and dressings were used and the man recovered.

BURNETT.

XIV.—GLAUCOMA.

141. BULL, C. S. An analysis of 90 cases of simple glaucoma with special reference to the effects of iridectomy on the acuteness of vision and the visual field. *Trans. Amer. Ophth. Soc.*, 1889.

142. FALCHI, FR. On not congenital hydrophthalmus. Beiräge zur pathol. Anat. u. zur allgem. Pathol., vol. vii.

143 GRUENING, E. Iridectomy in glaucoma. *Trans. Amer. Ophth. Soc.*, 1889.

144. LOGETSCHNIKOW, S. N. On some rare peculiarities of glaucoma. *Wjestnik Ophth.*, 1890, No. 3.

145. NATHANSON, A. On glaucoma in aphakial eyes. (From the St. Petersburg Ophthalmic Hospital.) *Wjestnik Ophth.*, Jan., Feb., March, April, 1890.

It would not be possible to do justice to this (141) carefully prepared and succinctly tabulated paper in a mere abstract. It should be read in full to understand its value in regard to the very important question of the advisability of iridectomy in simple glaucoma; and though the matter is left but little in advance of where the author found it, yet this little may be of great value in deciding upon some single indication as to whether or not an operation should be done in some specific case. His cases seem to lend us somewhat more hope from the operation. BURNETT.

GRUENING (143) divides his cases for study into (1) acute inflammatory glaucoma; (2) chronic inflammatory glaucoma without visible degeneration of the iris; (3) the same with degenerative changes; (4) simple glaucoma; (5) intermittent glaucoma. In the first form irridectomy was highly satisfactory; in the second the results are also satisfactory; in the third neither iridectomy nor sclerotomy do good—posterior sclerotomy may accomplish something; in the fourth class, simple glaucoma, he thinks iridectomy should always be done. He does not believe the operation injurious, and it often stops the progress of the disease. In the fifth class, intermittent glaucoma, reduction of vision often results from iridectomy. BURNETT.

LOGETSCHNIKOW (144) reports a case of acute glaucoma with a preponderance of the symptoms of irido-cyclitis (glaucoma iridis, glaucoma anterior), which returned in spite of sclerotomy, disappeared after a subsequent iridectomy, and notwithstanding its long duration and marked reduction of sight (to $\frac{1}{14}$) had not led after three years to an excavation of the papilla; a case of glaucoma with distinct swelling of the papilla, which did not disappear after an iridectomy,—the latter, however, reduced the tension which had not been greatly increased; a case of acute glaucoma in both eyes with marked papillitis, which, twelve days after iridectomy and double seclerotomy, respectively, on the other eye, was followed by deep glaucomatous excavations.

HIRSCHMANN.

NATHANSON (145) has carefully analyzed twenty-eight cases of glaucoma in aphakial eyes thus far reported, and nine observed

at the St. Petersburg Ophthalmic hospital. He divides them into two groups. In the first he places all cases in which the symptoms of glaucoma appear immediately or soon (a few weeks or months) after the operation, therefore depend upon the latter, and must be considered secondary glaucomas. In the second he places all cases, in which years have elapsed before the appearance of the glaucomatous symptoms. The cause of some of them may be found in the changes caused by the operation, which only an anatomical examination could reveal; they belong therefore among the secondary glaucomas. In many cases the idiopathic character of the disease cannot be questioned, and the course is a typical one. Glaucoma has been observed after all methods of operation (even after division of secondary cataract). The author believes, however, that the disease occurs more frequently after extraction without iridectomy. Undoubtedly there is a greater predisposition to secondary glaucoma after extraction without iridectomy, on account of the more numerous accidents.

HIRSCHMANN.

XV.—SYMPATHETIC OPHTHALMIA.

146. ABADIE, CH. Pathogénie et nouveau traitement de l'ophtalmie sympathique. *Ann. d'ocul.*, vol. ciii., p. 183.

147. BASEVI. Patogenesi microbica della oftalmia migratrice. *Ann. di ottalm.*, vol. xix., 1, p. 57.

148. COPPEZ. Clinique ophtalmique de l'hôpital St. Jean. *Rev. gén. d'opht.*, 1890, p. 97.

149. GAYET. Recherches anatomiques sur une ophtalmie sympathique expérimentale. *Arch. d'opht.*, vol. x., No. 2, p. 97.

150. GUAITA. Studio anatomico clinico sulla exenterazione del globo oculare. *Ann. di ottalm.*, vol. xix., 1, p. 3.

151. OHLEMANN, M. Perforating injuries of the eyes with reference to the occurrence of sympathetic opthalmia. *Arch. f. Augenhk.*, vol. xxii., p. 94.

ABADIE (146) has endeavored to treat sympathetic ophthalmia with injections of sublimate. He obtained good results with this method in three cases, which he reports. He injects two drops of a solution of sublimate (1:1000) into the injured eye, and when the other eye is also severely affected he likewise injects a drop of the same solution. MARCKWORT.

BASEVI (147) has seen a severe reaction, and in two cases death of the animal experimented upon, follow inoculation of the anterior chamber or vitreous with pure cultures of staphylococcus, but never the development of sympathetic ophthalmia in the other eye. He found, however, a small, moderately mobile bacillus, besides streptococci and staphylococci in the tissues, and especially in the optic nerve of enucleated eyes, which had caused sympathetic ophthalmia. Pure cultures of this bacillus on agar or gelatine, and introduced into the vitreous or optic nerve of a healthy eye, produced chronic irido-cyclitis, and about a week later sympathetic lesion of the other eye. In twenty experiments on rabbits, the primary reaction developed in sixteen and the sympathetic in eleven cases. In five carefully examined human eyeballs, which had been enucleated on account of sympathetic inflammation of the other eye, the author found this bacillus, together with strepto- and staphylococci, and in especially large numbers in the region of the ciliary body. DANTONE.

COPPEZ (148) ably and energetically defends enucleation for sympathetic ophthalmia against Wecker's attacks. (*Cf.* de Wecker, L'abus de l'énucléation, *Ann. d'ocul.*, vol. cii., p. 192.) MARCKWORT.

GAYET (149) inoculated the left eye of a rabbit with spongy granulations taken from a lachrymal sac, and saw iritis develop after a month, and two weeks later a severe inflammation resembling sympathetic ophthalmia in the other eye. He found the lens infiltrated with round cells, the retina detached, interstitial neuritis of the left optic nerve, the left half of the chiasm sclerosed, and without a trace of nerve fibres. In the right optic nerve he also found interstitial neuritis, which, however, did not reach the globe. In the second eye he mainly found sclero-keratitis, with formation of an abscess and vascularity of the cornea. Gayet thinks the deleterious substances were first carried through the optic nerve to the chiasm, and then to the other eye, leaving the optic nerve, however, at the entrance of the central blood-vessels, and reaching the corneal margin with the subdural lymph-stream. v. MITTELSTÄDT.

GUAITA (150) comes to the following conclusions in regard to exenteration: 1. Enucleation is absolutely indicated in malignant tumors and sympathetic ophthalmia; exenteration in panophthalmitis and retro-ocular suppuration. 2. Enucleation is preferable in painful phthisis, exenteration in hydrophthalmic degeneration,

total corneal staphyloma, absolute and hemorrhagic glaucoma. He uses no sutures whatever, removes the contents of the globe with a disinfected sponge, cauterizes superficially with the red-hot iron, inserts merely a strip of gauze for drainage, makes cold applications with a sublimate solution (1 : 1000), and of course observes strict antiseptic precautions. DANTONE.

XVI.—LENS.

152. CICARDI. Due casi di sublussazione della lente cristallina. *Ann. di ottalm.*, vol. xviii., 6, p. 548.

153. ROBERTS, JOHN B. Extraction of cataract. *Med. Progress*, Jan., 1890.

154. SCHIRMER, O. Supplementary remarks on the pathological anatomy of zonular cataract. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 1, p 135.

155. SWANZY, H. R. Remarks on a series of one hundred cataract extractions. *Brit. Med. Jour.*, March, 1890, p. 531.

156. TROUSSEAU. Les maladies générales et l'opération de la cataracte. *Soc. d'opht.*, 1890, p. 145.

CICARDI (152) describes two cases of partial traumatic dislocation of the lens, in which he succeeded in restoring the lens to its normal position with the aid of eserine, compressive bandage, and rest. At the first examination of both patients he found a myopia of 5 D, which finally disappeared almost entirely, while sight rose to $\frac{20}{40}$ and $\frac{20}{30}$ respectively. DANTONE.

ROBERTS (153) uses the customary aseptic precautions. He makes the upward incision and an iridectomy. His dressing is a semi-ellipse of plaster applied to the upper lid alone, holding it stiff like a splint, the lower lid remaining free. No bandage is applied, and the patient is allowed much freedom of movement. Thirteen cases are reported in more or less detail, all successful. BURNETT.

SCHIRMER (154) proves with the microscope that the globules, which make up the opaque layer in zonular cataract and also penetrate into the nucleus, are present during life, and are not the result of hardening in alcohol.

SWANZY (155) operates by the "3-*mm* flap" method, observing strict antiseptic precautions. Iridectomy is always performed, the capsule freely divided, lately by transverse scorings only. The cortex is removed by the lid manœuvre. The author makes

a point of searching the corneal wound with an iris forceps, in order to remove any bits of capsule which may have lodged in it. Tags of capsule had to be removed in nine cases. Good sight was obtained in 93 %, moderate in 5 %, loss 2 %. In the discussion of the merits of operating with or without an iridectomy, the size and position of the coloboma is constantly left out of view. The author makes the iridectomy above, and from 2 to 4 *mm* wide in the centre. That the average acuteness of vision is higher in simple extraction requires proof. The high average obtained in Professor Knapp's last report is rather due to the number of discissions, 74, as against 21 performed by the author. WERNER.

TROUSSEAU (156) believes that in operating for cataract in cases of diabetes and albuminuria there is no special cause for apprehension. He thinks the chances of success are smallest in patients with cerebral affections and in topers.

MARCKWORT.

XVII.—VITREOUS.

157. HILL-GRIFFITH. The artificial vitreous body. *Brit. Med. Jour.*, Feb., 1890, p. 293.

158. HARLAN, G. C. Extensive vascular growth in vitreous. *Trans. Amer. Ophth. Soc.*, 1889.

HILL-GRIFFITH (157) has performed Mules' operation 11 times up to the end of 1886, and in 2 only the glass sphere came out; one of these was considered a very satisfactory example of the completed operation. The author has not found that a drain of any kind has mitigated the severe reaction which follows; he uses thick silk sutures passed through conjunctiva and sclerotic. The entire operation takes ten minutes. WERNER.

HARLAN'S (158) case is accompanied with a good figure, which shows a triangular network of delicate blood-vessels extending into the vitreous from the optic disc, but not originating from the retinal vessels. Vision was fairly good. As there were hemorrhages Harlan thinks these vessels may have originated in them. The vessels were disappearing at the last examination.

BURNETT.

XVIII.—RETINA AND FUNCTIONAL DISTURBANCES.

159. AYRES, S. C. Retinitis pigmentosa treated by injections of strychnine. *Amer. Jour. Ophth.*, Oct., 1889.

160. BERRY. Note on a stereoscopic effect and its application. *Ophth. Rev.*, vol. ix., p. 103.

161. DARIER, A. Dégénérescence cystoïde bilatérale de la rétine à évolution lente et progressive. *Arch. d'opht.*, vol. x., No. 3, p. 203. With illustrations.

162. DOMMARTIN, Cécité subite consécutive à un traumatisme de la région occipitale. *Arch. de méd. et de ph. milit.*, 1890, No. 3, p. 211.

163. HARLAN, G. C. Hysterical blindness of ten years' duration in a healthy male subject. *Trans. Amer. Ophth. Soc.*, 1890.

164. HOFFMANN, J. Experiences on traumatic neurosis. *Berliner klin. Wochenschr.*, 1890, p. 655.

165. LOGETSCHNIKOW, S. Cases of cure of detachment of the retina. *Wjestnik Ophth.*, 1890, No. 2.

166. MORTON, H. S. Obstructed retinal circulation. *Ophth. Rev.*, vol. ix., p. 65.

167. OSTEN-SACKEN, LEO VON DER. The progressive peripheral pulse of the retinal veins. Dorpat, Schnakenburg, 1890.

168. PROBSTING. A case of retinitis proliferans. *Zeh. klin. Monatsbl.*, vol. xxviii., p. 73. Can find no definite cause.

169. RITTER, J. Contribution to the knowledge of traumatic neurosis. *Berliner klin. Wochenschr.*, 1890, p. 361.

170. RITZMANN, E. The hypnotic suggestive treatment in diseases of the eye. *Correspondenzbl. f. Schweizer Aertze*, 1890, p. 79.

171. SCHLEICH. Contribution to the knowledge of the spontaneous development of connective tissue in the retina and vitreous (retinitis proliferans [Manz]). *Zeh. klin. Monatsbl. f. Augenheilk.*, vol. xxviii., p. 63. He attributes it to hemorrhages into the retina and vitreous.

172. UHTHOFF, W. Contribution to hemeralopia and xerosis conjunctivæ epithelialis. *Berliner klin. Wochenschr.*, 1890, p. 630.

AYRES' (159) case was that of a girl of eleven years who had the typical retinal picture of retinitis pigmentosa with a visual field of only 10°. After injections of strychnine daily for thirteen days it increased gradually to 30° downward, 40° outward, 22° inward, and 20° upward. Central vision also improved.

BURNETT.

In BERRY'S (160) stereoscopic pictures, each eye has presented

to it two concentric circles, the smaller central one being capable of lateral movement. If binocular vision exists, the effect appears to be that the central ring approaches or recedes from the observer; if not, the lateral movement alone is seen. WERNER.

DARIER (161) observed for four years some peculiar changes in the right eye of a woman aged thirty-three, whose left eye had been removed ten years previously. There was a whitish projecting spot downward and outward from the papilla, from which a delicate network developed into the vitreous, while the fundus was gradually converted into a white, nodular surface, with blood-vessels running over it. V finally sank to $\frac{1}{\infty}$. Microscopic examination of the left eye showed cystoid degeneration of the retina, and the affection of the right was probably of a similar nature. V. MITTELSTÄDT.

DOMMARTIN (162) saw the following interesting case: A workman aged fifty-five received a powerful blow on the back of the neck, was unconscious for twenty-four hours and blind on awakening. The appearance of the fundus was normal and the pupillary action preserved. After some time sight returned. Dommartin thinks that a hemorrhage had taken place which had compressed the cortical centres. MARCKWORT.

In HARLAN'S (163) case, that of a man of twenty-two years, with no history of any nervous derangement of any kind, there was a supposed blindness of one eye, which, however, under the tests was shown capable of vision. He was finally convinced that he could see and thereafter did see. The delusion had existed for ten years. BURNETT.

Among twenty-four cases examined by HOFFMANN (164) six exaggerated their symptoms and eight were simulants. The majority of authors have declared simulation of the whole well-known clinical picture impossible. Only ten of the twenty-four were tested in regard to the visual field, which was found contracted in three and of normal extent in seven cases.

In a case of unquestioned detachment of the retina with iridodialysis and hemorrhage, the result of a blow with a whip, LOGETSCHINKOW (165) saw recovery take place in nine days after instillation of atropine. HIRSCHMANN.

MORTON (166) considers that the arterial tension should be systematically examined, in case of obstructed retinal circulation. He records two cases presenting appearances of embolism or thrombosis associated with high arterial tension; in one there

were albuminuria and aortic regurgitation, in the other only slight hypertrophy of the heart. A third case is described of obstruction of the retinal vessels occurring after several paroxysmal failures of sight accompanied with migraine, a condition in which high arterial tension exists, as shown recently by Dr. A. Haig.

WERNER.

OSTEN-SACKEN (167) concludes that the physiological venous pulse dependent upon the pressure in front of and behind the lamina cribrosa is aided by the variations in pressure in the cavernous sinus. In insufficiency of the aorta, in 30 % of all cases of general arterio-sclerosis, but not in valvular disease of the heart, and in many cases of anæmia and chlorosis, the pathological peripheric progressive venous pulse is found. He thinks it is due to the fact that the arterial pulse extends farther than under normal conditions and through the capillaries into the veins.

One of RITTER'S (169) cases is remarkable from the fact that only the organs of sense, sight, hearing, smell, and taste were affected. There was also paresis of the facial and hypoglossus nerves.

RITZMANN (170) reports the cases of two women suffering with blepharospasm and anæsthesia of the retina, which did not yield to the usual methods of treatment, but quickly to hypnotic influence.

UHTHOFF (172) presents an extensive review of the literature of our knowledge of hemeralopia and xerosis, and also attributes it mainly to strong sunlight and imperfect nourishment. He thinks he has found another cause in chronic alcoholism. Among 1,500 demented men, one third of whom were topers, there were 27 cases of hemeralopia.

XIX.—OPTIC NERVE.

173. CIRINCIONE. Tuberculosi del nervo ottico. *Giorn. di neuropatologia*, vol. vii., 2.

174. MACNAMARA, N. C. Rheumatic neuritis and neuro-retinitis. *Brit. Med. Journ.*, May, 1890, p. 1007.

175. PHILLIPS, T. Reports of cases. *Royal London Ophth. Hosp. Rep.*, vol. xii., 4, p. 331.

176. SCHEFFELS, O. On resection of the optic nerve. *Zeh. klin. Monatsbl.*, vol. xxviii., p. 197.

177. Ulrich, R. A case of uniocular incipient choked disc, with bilateral partial atrophy of the trunk of the optic nerve. *Arch. f. Augenhk.*, vol. xxii., p. 32.

Cirincione (173) describes a tumor 14 × 18 *mm* which surrounded the optic nerve in the region of the posterior attachments of the ocular muscles. Careful examination under the microscope proved it to be a genuine tuberculous tumor, which penetrated the optic nerve and its sheaths, and had undergone partial fatty degeneration. The eye was taken from a girl aged eleven, who had died of basilar meningitis, and had been set aside for examination on account of extensive ectropium, hypertrophy of the lachrymal gland, and numerous corneal opacities. The author mentions that only three cases of tuberculosis of the optic nerve have been reported. In two of them (Cruveilhier and Hjort) the intracranial, and in one (Sattler) the orbital part of the nerve was affected. Dantone.

Macnamara (174) records particulars of two cases of neuroretinitis confined to one eye in young individuals with history of rheumatism. In both cases the attack was acute, the eye being very painful, especially on movement or on pressure. $V = \frac{1}{\infty}$, but there was great photophobia. Under anti-rheumatic treatment vision rose in one case to 0.6 Snellen, and in the other to Snellen 5. The discs remained white. The author also refers to ulcers of the cornea connected with rheumatism. Werner.

Phillips (175) records the case of a girl, æt. eighteen, who for five months was subject to optic neuritis at repeated intervals. Iodide of potassium and cod-liver oil always produced a beneficial effect. In the second case, a man, æt. thirty-four, got a blow on the head with a piece of iron ; no open wound ; was unconscious for three weeks. There was a depressed fracture over the posterior superior angle of the left parietal bone. $V = \frac{20}{200}$. Well-marked right lateral hemianopsia. There appears from the charts to be some contraction of the rest of the field, especially in the left eye. Werner.

Scheffels (176) reports on forty-one resections performed at the Wiesbaden Ophthalmic Hospital during the last seven years, and concludes from the clinical experience that resection performed correctly and at the right time protects against sympathetic ophthalmia. The operation was performed in fifteen cases in which the patients were suffering directly and exclusively from the blind eye, and in twenty-six in which sympathetic ophthalmia

was feared. Pagenstecher attaches the divided muscle to the sclera. Finally he opposes Deutschmann's well-known experiments and the conclusions drawn therefrom.

XX.—INJURIES, FOREIGN BODIES (PARASITES).

178. COLLINS. Curator's pathological notes. *Royal London Ophth. Hosp. Rep.*, vol. xii., p. 334.

179. DUJARDIN. Blessure de l'œil. *Jour. des sci. méd. de Lille*, 1889, No. 26, p. 601.

180. FISCHER, E. Extraction of chips of iron from the vitreous. *Arch. f. Augenhk.*, vol. xxii., p. 18.

181. FUMAGALLI. Corpo straniero nell' occhio sinistro. *Ann. di ottalm.*, vol. xviii., 6, p. 544.

182. HUTCHINSON, J., Jr. Unusual cases of injury to the eye and orbit. *Royal London Ophth. Hosp. Rep.*, vol. xii., 4, p. 305.

183. MAGAWLY. Cysticercus in the eye. *Wjestnik. Ophth.*, 1890, No. 1.

184. SATTLER. On injuries to the eyes. *Prager med. Wochenschr.*, 1890, 1.

185. SCHIRMER. Two cases of rare injury to the eyes. *Deutsche med. Wochenschr.*, 1890, p. 457.

186. VOSSIUS, A. An operation for cysticercus. *Berliner klin. Wochenschr.*, 1890, p. 7.

187. WADSWORTH, O. F. Two cases of extraction of steel from the vitreous which had passed through the lens. *Trans. Am. Ophth. Soc.*, 1889.

COLLINS (178) describes the following conditions: (1) Dragging forward of the retina in the region of the ora serrata without general detachment; (2) three cases in which a foreign body, after entering the eye, rebounded from the back of the globe; (3) hernia of the lens through a perforation in the cornea, after rupture of an ulcer, and also after Saemisch's incision; (4) rupture of the globe, with displacement of the lens. After enumerating several other cases, the author recommends non-interference with a lens dislocated under the conjunctiva, if there be no pain.

WERNER.

FUMAGALLI (181) saw a case of foreign body (piece of gun-cap in an atrophic eyeball), which had caused sympathetic ophthalmia attended with the most severe general symptoms, and even

epileptiform convulsions. After enucleation of the eyeball the symptoms rapidly disappeared. DANTONE.

HUTCHINSON (182) records the following cases amongst others: A tin tack penetrating the eye and lodging in the vitreous humor; brick dust filling up half of the anterior chamber; a slate-pencil almost two inches long embedded in the orbit for several weeks, the eye escaping injury. Finally a case of complete removal of lens and iris, by a blow of a pipe-stem or piece of iron, with retention of V = $\frac{20}{30}$ with + 13 D. WERNER.

MAGAWLY (183) publishes a case of successful extraction of a cysticercus from the vitreous; intraocular cysticerci, as well as the tænia itself, being a very rare occurrence in Russia. (The reviewer saw one case among 130,000 patients.)

HIRSCHMANN.

SATTLER'S (184) paper principally considers the complications in non-perforating injuries to the globe, such as rents of the sphincter, iridodialysis, opacities of the lens, rents of the capsule, dislocations of the lens, ruptures of the choroid, etc. In perforating injuries the principal indication is the prevention or treatment respectively of infection, as sympathetic ophthalmia frequently follows.

SCHIRMER (185) saw a case of rupture of the anterior capsule of the lens with an uninjured cornea, and a triple rupture of the sphincter of the iris. In regard to the cause of the latter, he is of the opinion that the iris is caught between the cornea and lens under the influence of the trauma, whereupon the free edge tears, as it cannot escape.

VOSSIUS (186) succeeded in extracting a cysticercus from the vitreous. Four weeks after the operation, V = $\frac{1}{3}$. He then describes the technique of the operation, and reviews the frequency of the occurrence of the parasite.

The first case of WADSWORTH (187) was that of a boy, of thirteen, into whose vitreous a small piece of steel had entered through the centre of the cornea and lens. The body was easily seen lying just behind the lens, which remained quite clear, and was extracted with an electro-magnet through a scleral incision. No reaction followed, but a complete cataract was the final result. He was killed by a railway accident before any further interference was instituted. Case 2 was a man of thirty-one years. A bit of steel entered the vitreous through the lower part of the cornea, iris, and lens. It was removed through a scleral incision

with an electro-magnet. He did well for two months, when internal inflammation, accompanied with deposits of pigment on the disc and elsewhere, set in, and it finally resulted in a detachment of the retina, which however did not begin at the point of the scleral incision. The lens did not become wholly opaque.

BURNETT.

XXI.—OCULAR AFFECTIONS IN CONSTITUTIONAL DISEASES.

188. ADLER, A. On affections of the eyes due to influenza. *Wiener med. Wochenschr.*, 1891, p. 141.

189. ADLER, A. A case of subcortical alexia (also called optical aphasia). *Berliner klin. Wochenschr.*, 1890, p. 357. The affection is probably due to a destruction in the left occipital lobe and gyrus angularis.

190. BADAL and A. FAGE. Complications oculaires de la grippe. *Arch. d'opht.*, vol. x., No. 2, March-April, 1890, p. 136.

191. BERLIN. Purulent iridochoroiditis after influenza. Paper read before the Society of Rostock Physicians, March 8, 1890. *Correspondenzbl. d. allg. Mecklenburg Aerzte-Vereins*, 126, p. 282.

192. BOCK, E. Ophthalmic and aural experiences during an epidemic of influenza. Paper read before the Society of Physicians at Krain, Feb. 26, 1890.

193. BONO. L'oculistica e la medicina in generale. *Gazz. med. di Torino*, vol. xli., 14, p. 345.

194. VAN DEN BERGH. Un cas de métastase oculaire dans l'infection puerpérale ; énucléation ; guérison. *La Clinique*, 1889, p. 513.

195. BULL, C. S. Case of double choked disc, due to intracranial tumor, with autopsy. *Trans. Amer. Ophth. Soc.*, 1889.

196. COHN, S. Uterus and eye. Description of the functions and diseases of the female sexual organs and their pathological effect on sight. Wiesbaden, Bergmann, 1890.

197. DENTI. L'influenza e le malattie oculari. *Ann. di ottalm.*, vol. xix., 1, p. 77.

198. DAMSCH, O. On pupillary unrest (hippus) in diseases of the central nervous system. *Neurol. Centralbl.*, 1890, p. 258.

199. EVERSBUSCH. On the ocular affections occurring in influenza. *Münchener med. Wochenschr.*, 1890, p. 89.

200. FOERSTER. On cortical blindness. *v. Graefe's Arch. f. Ophth.*, vol. xxxvi., 1, p. 94.

201. GROENOUW, A. Five cases of paralysis of accommodation in meat-poisoning (ham). *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxviii., p. 166.

202. HINSHELWOOD, J. Temporary cycloplegia after head injury. *Brit. Med. Jour.*, Feb., 1890, p. 292.

203. MACNAMARA, A. C. Malarial neuritis and neuro-retinitis. *Brit. Med. Jour.*, March, 1890, p. 540.

204. NATHANSON, A. Case of influenza with pleuro-pneumonia and binocular embolic irido-choroiditis. *Petersburger med. Wochenschr.*, 1890, p. 213.

205. OLIVER, C. A. An analysis of some of the ocular symptoms observed in so-called general paresis. *Trans. Amer. Ophth. Soc.*, 1890.

206. RAMPOLDI. Affezioni oculari nell' corso dell' epidemia della "influenza." Nota clinica. *Ann. di ottalm.*, vol. xviii., 6, p. 515.

207. RAMPOLDI. Sopra alcune affezioni oculari in rapporte con la cosi della influenza. *Ann. di ottalm.*, vol. xix., 1, p. 70.

208. REMACK, E. Basal hemianopsia. *Neurolog. Centralbl.*, 1890, p. 130.

209. SÉDAN. Contribution à l'étude des symptomes oculaires observés pendant l'épidémie d'influenza. *Rec. d'opht.*, 1890, p. 137.

210. SIMI. Influenza. *Boll. d'ocul.*, vol. xii., 3, p. 2.

211. ST. JOHN, L. B. Case of hemianopsia with peculiar cerebral symptoms. *Trans. Amer. Ophth. Soc.*, 1889.

212. SULZER, D. E. (of Winterthur). Troubles de la vision dans l'impaludisme. *Arch. d'opht.*, vol. x., 3, May–June, 1890, p. 195.

213. WOLLENBERG, R. Two cases of tumor of the posterior cranial fossa. *Arch. f. Psychiatr. u. Nervenkrankh.*, vol. xxi., 3, p. 778.

ADLER (188) saw all kinds of eye-diseases after influenza, but finally comes to the conclusion that there is no form characteristic for influenza.

BADAL and FAGE (190) report on 30 cases of eye-disease observed at the university clinic at Bordeaux after influenza. In the majority of cases the conjunctiva, cornea, and lids were affected; in two there was iritis and in the same number irido-choroiditis,

once with loss of the eye. One case of acute glaucoma is remarkable, another of paralysis of the superior rectus, and one of the external rectus, and one of amblyopia without any visible changes. The affections occurred both at the beginning and during the period of convalescence, and were especially severe in the latter. Diatheses, rheumatism, and scrofula, as well as previous ocular affections, favored their development. The paralyses are the same as those which occur after other infectious diseases, diphtheria and typhoid fever. The authors consider it probable that the microbes of the conjunctival sac, which in a healthy state of the body are inactive, can produce infection in constitutional diseases.

v. MITTELSTÄDT.

BULL'S (195) patient was a married woman of twenty-three, who suffered from vertex headache and double optic neuritis for more than a year, during the latter part of the time being blind, and with numerous indices of central brain lesion—hemianæsthesia, loss of smell, loss of memory, etc. A nodulated tumor was found involving the corpora quadrigemina, extending to the anterior crura of the cerebellum and into the left hemisphere and involving the thalamus and internal capsule. Forward it extended from the thalamus to the left occipital gyrus. The anterior corpora quadrigemina were dislocated forwards. The ventricles were enormously distended. The tumor was a glio-sarcoma.

BURNETT.

The contents of COHN'S (196) careful monograph are given in the title. For details the original must be consulted. The bibliography embraces 219 numbers, which refer to the connection between female diseases and affections of the eyes, making the book a valuable acquisition to any library.

The ocular affections observed by DENTI (197) during an influenza epidemic, the connections of which with the latter could be traced with certainty were : œdema of the lids, acute conjunctival catarrh, congestion of the conjunctiva with severe supraciliary pain, profuse lachrymation and contraction of the pupil, etc., also severe, certainly infectious, corneal ulcers, small, deep, frequently penetrating ulcers, congestion and inflammation of the iris and choroid with hypopyon, the outer membranes being uninjured, and opacities of the vitreous. In five of them there was increase of tension and slight mydriasis, so that an iridectomy became necessary. The author also saw several times asthenopia and paresis of accommodation, and in three cases distinct neuro-retinitis.

DANTONE.

DAMSCH (198) observed hippus, aside from affections of the eye itself, in changes in the chiasm with subsequent hemianopsia, in paralysis of the oculo-motor nerve, in nystagmus, in epilepsy, in the early stage of acute meningitis, but relatively most frequently in multiple sclerosis. He also found it in cerebral affections, in which there were simultaneously other symptoms of motor or sensory irritation. Into this category belong acute meningitis and circumscribed affections after apoplexies. In chorea there was no hippus. Neurasthenic patients showed it occasionally.

EVERSBUSCH (199) mentions keratitis dendritica, also a peculiar painful sensation in the orbit, which becomes especially severe after accommodative efforts, and which he ascribes to difficulty of contraction of the participating muscles, and which has an analogy in the pain in the muscles of the back and extremities. The affections of the conjunctiva and the œdemas of the lids do not differ from the usual catarrhal affections. He also saw cases of glaucoma, serous irido-choroiditis, purulent choroiditis, and weakness of accommodation.

FOERSTER (200) saw a post-office secretary, aged forty-four, without syphilitic taint, who came to him in 1884 with an almost complete defect of the right halves of both visual fields. Vision gradually rose to $\frac{5}{10}$. In 1889 the left halves of the visual field were lost within a few days. The patient made the impression of a blind person. Closer examination, however, showed that a small central part on both sides retained its function with $V = \frac{1}{3}$. Colors could not be recognized. Foerster attributes the affection to thrombosis of the cortex. There were no symptoms of loss of function in any other part of the body. It was worthy of note that he had lost the power of picturing to himself the relative position of things in space. Foerster designates this as a loss of memory of place, and concludes that this faculty is dependent upon integrity of the occipital lobe. The fact that useful sight was preserved in a small area argues against the assumption that the macula lutea is supplied both by the crossed and uncrossed fibre-bundles. He sets up the hypothesis that, as the sensory-retinal elements always correspond to neighboring elements of the cortex, in case of thrombosis of the principal blood-vessel of the occipital lobe that part which corresponds to the macula lutea receives nourishment from another source, in consequence of numerous anastomoses, and therefore its function is preserved.

The case also shows that destruction of the cortex of the occipital does not cause atrophy of the optic nerve.

In patients, who had eaten a large quantity of ham, GROENOUW (201) found besides paralysis of accommodation moderate mydriasis and very sluggish pupillary reaction; in others the pupils responded promptly. In regard to the differential diagnosis, it is important to note that marked mydriasis with slight paralysis of accommodation indicate the internal exhibition of atropine, and not meat poisoning.

HINSHELWOOD (202) records the case of a lad, aged seventeen, who fell down a ship's hold, receiving two scalp-wounds, but no fracture. He remained semi-comatose for two weeks, and the third week he was very irritable and easily excited. On the sixteenth day internal strabismus occurred from paralysis of the external rectus. Four days later the pupils were widely dilated, reacted on light, but not on convergence or accommodation. Patient could only read J 20, but with + 6 D, J 1. Distant V normal. Fundus normal. Patellar reflexes exaggerated. Accommodation recovered in eight days. WERNER.

MACNAMARA (203) records four cases of neuro-retinitis in patients who were subject to attacks of malarial fever. The defect of vision, which occurred during the attacks, and was due to neuro-retinitis, as shown by figures of the disc and tortuous veins, with minute hemorrhages, was cured with quinine and strychnine. The spleen was enlarged, there was no anæmia, no evidence of syphilis or rheumatism, no indication of serious renal mischief. The author is inclined to believe that the inflammation is due to the formation of ptomaines by microbes. WERNER.

NATHANSON'S (204) patient had had influenza in November, 1889. In the third week of January, 1890, pleuro-pneumonia set in, and on March 6th the left eye, and on the 8th the right eye, became blind.

OLIVER (205) has examined twenty cases of general paralysis—all men—in the second stage of the disease, and found evidences nearly always of lowered sensory nerve response on the part of the eye, and more or less implication of the ocular motor apparatus. The eyes generally showed evidences of wear and tear.

BURNETT.

RAMPOLDI (206) has observed the following conditions of the eyes attending and following influenza: Decided pain on movement of the globe, paresis of accommodation and paralysis,

blepharospasm, congestion of the globe with increased lachrymation and photophobia, panophthalmitis from inflammation of old leucomas, increased tension even to an attack of glaucoma.

DANTONE.

RAMPOLDI (207) makes a second report on the ocular affections observed by himself in connection with influenza. Among 532 eye-patients whom he saw during the months of February and March, 1890, there were forty-five who had acquired their ocular trouble during or after an attack of influenza. These affections were: five cases of acute conjunctivitis, one of conjunctival abscess, five of abrasion of the corneal epithelium with anæsthesia of the spot, six of corneal infiltrations, one of corneal abscess, one of hypopyon-keratitis with acute irido-cyclitis, two of serpent ulcer, one of diffuse keratitis with serous iritis, one of simple serous iritis, one of glaucomatous irido-cyclitis, one of metastatic choroiditis (with loss of the eye), one of detachment of the retina in both eyes from serous choroiditis, six of supraorbital neuralgia, three of blepharospasm, two of spasmodic twitching of the lower lid, two of accommodative asthenopia, two of paralysis of accommodation, one of paralysis of the abducent, one of panophthalmitis of a previously healthy eye in a woman who had an adherent leucoma on the other eye. Among six cases of glaucoma there were two which most probably could be attributed to the prevailing epidemic. The experiments with the products of disease to find some special microbes failed. DANTONE.

The symptoms in REMACK'S (208) case were right-sided ptosis and paresis of the superior rectus, left-sided hemianopsia with partial atrophy of the optic nerve, and slight spastic paresis of the left lower extremity. In consideration of the circumstance that the limitation of the visual field had also affected the other half of the field, the focus of disease was referred to that part of the base where the tractus passes from above, behind, and outwards, downwards, inwards, and forwards across the pedunculus cerebri, and passes over the oculomotor, emerging from the latter.

SÉDAN (209) observed in a boy aged seven the certainly rare occurrence of blindness lasting two days during an attack of influenza. He was not consulted until after the blindness had disappeared, and could no longer find anything abnormal in the eyes.

MARCKWORT.

SIMI (210) saw in three persons, who had a choroidal affection

and were attacked with influenza in the meantime, decided aggravation of the ocular disease. In four cases of simple and in one case of pustular conjunctivitis, which had developed during the influenza, he saw severe ciliary irritation, and in a sixth case during an influenza-pneumonia the formation of an atonic corneal ulcer, with perforation of the membrane and prolapse of the iris.

DANTONE.

ST. JOHN'S (211) case was that of a man who had had intense malaria, and who developed a nasal hemianopsia of both eyes—central vision being good—for which no cause could be found. The case was watched through five years. At last report central vision had declined to $\frac{15}{15}$ and $\frac{15}{6}$, the hemianopsia complete in the right eye, in the left less so; has feeling of pressure in the head, and is confined to bed. BURNETT.

SULZER (212) presents a review of the ocular affections ascribed to malaria and adds a discussion of his experiences made in Java on soldiers of the Dutch colonial army. He saw most frequently optic neuritis in malarial cachexia. The frequent and marked variations in sight were characteristic. $V = \frac{1}{10}$ can rise in two to three weeks to $\frac{1}{2}$ or $\frac{2}{3}$, and in a few days go back again. In most cases the neuritis is binocular, but at first almost always confined to one eye. The field of vision is normal or concentrically contracted, color-perception normal, except in cases which end in atrophy. The dark coloration of the swollen papilla is also characteristic—a true melanosis. In 8 per cent. partial atrophy set in; in one third of the cases there were peripheric hemorrhages, which disappeared without a trace. Another manifestation of malaria is seen in the diffuse infiltration of the vitreous, which may become so intense that the papilla appears perfectly white. Atrophy of the latter is seen when the vitreous clears up, which, however, rarely takes place completely. Another variety of disease observed in the acute attacks, especially of febris tertiana in 20 per cent., consisted in a marked and even in the normal period persistent hyperæmia of the retina and the slightly swelled papilla. The choroid appeared as though covered wieh a delicate haze. The patients complain of severe stinging pain, photophobia, and flashes of light. This variety is inclined to develop into an affection of the macula lutea, similar to that observed after careless observation of an eclipse of the sun. The author found it in those malaria patients who came under his treatment on account of dazzling after long marches on the sandy coasts of Borneo, while

otherwise such indirect dazzling did not lead to an affection of the macula. From the two latter forms the patients recover; chorio-retinitis only follows when malaria-cachexia supervenes. In conclusion the author sub-divides the affections as follows: (1) chronic optic neuritis; (2) diffuse infiltration of the vitreous; (3) peripheric punctate retinal hemorrhages; (4) sudden and permanent amaurosis. Acute attacks produce: (1) temporary amblyopia and amaurosis without any ophthalmoscopic changes; (2) diffuse affection of the vitreous with complication of the macula lutea; (3) extensive hemorrhages around the papilla and macula. v. MITTELSTÄDT.

In one of WOLLENBERG'S (213) cases there was a tumor of the temporal lobe which, besides the disturbances, had caused hemianopsia; in the other there was a tumor of the cerebellum with the following symptoms: disturbances of equilibrium, dizziness, headache, with stiffness of the neck. Early development of choked disc ending in amaurosis, marked nausea, but rarely vomiting. He also found limitation of the movements of the eyes, nystagmus, and symptoms of paralysis of facial and hypoglossal nerves.

MISCELLANEOUS NOTES.

Privat-docent Dr. UHTHOFF, of Berlin, has been appointed Professor of Ophthalmology at Marburg in place of Professor SCHMIDT-RIMPLER, who has been called to Goettingen.

Dr. K. MELLINGER has established himself at Basel as "privat-docent" for ophthalmology.

Privat-docent Dr. A. MAKLAKOW has been appointed Professor extraordinarius at Moscow.

Dr. J. MITVALSKY has established himself as "privat-docent" for ophthalmology at the Czech University at Prague.

Privat-docent Dr. BUNGE, in Halle, has been appointed Professor extraordinarius, and to replace Prof. A. GRAEFE at the University during the latter's illness.

Dr. FEUER has established himself at Budapest as "privat-docent" for ophthalmology.

Dr. EMIL GRÜNING has been appointed ophthalmic surgeon to the N. Y. Eye and Ear Infirmary, to fill the vacancy caused by the death of Dr. Cutter.

Extension of the New York Eye and Ear Infirmary, SECOND AVE., COR. 13TH ST. During the past five years the rapidly increasing numbers in attendance at the Infirmary have demanded increased facilities for treatment, but it was not until the early part of the year 1890 that any work in that direction was begun. Since that time a large addition has been made to the old building, which has also been remodelled. The whole now forms an institution of ample accommodation and proper equipment.

In the first place, whereas in former years in the Eye Department the space allotted for the reception and treatment of the vast

numbers of walking cases that come here was limited to one or two rooms, wherein the surgeons and patients suffered much from the confined quarters; to-day they have at their disposal large and airy accommodation in which each surgeon, having his own room and own facilities, can, with greater satisfaction, treat the cases allotted him. In like manner the surgeons of the ear and throat department suffered, while at present there are suitable spaces and conveniences for the carrying on of their special work.

The operating-room, in which over a thousand operations are yearly performed, has been thoroughly overhauled and put in a completely aseptic condition.

In order to carry out the same idea of antisepsis a special room has been set apart for an operating-room for the Ear Department, inasmuch as the majority of cases of this class upon which operations become necessary are of a purulent and contagious character. Through the benevolent munificence of a friend of the institution[1] a room, with ward attached, capable of containing six beds has been endowed as an operating-room and special ward for Throat cases.

The old wards, which in some cases were scarcely habitable, have undergone a most extensive change, and to them have been added large and airy ones, suitably arranged with all the latest appliances for the patients' health and comfort. With this increase in our hospital capacity ample provision can be made for cases of a special nature, while those of an infectious character can be properly isolated.

In addition to the above increased space a certain allotment has been made for the reception of special cases, who do not care to be placed in the larger wards with others about them but prefer more privacy and retirement, in the shape of smaller rooms upon a separate floor.

The total amount of available space for the maintenance of patients consists of about 20 rooms, containing in all ample accommodation for about 120 beds, of which about 50 are already in use.

The whole building has been heated in the latest approved manner, and the furnishing of the institution has been performed with the strictest regard for antiseptic cleanliness and good ventilation.

A. D. HARVEY, M.D., House Surgeon.

[1] Mrs. C. F. McLean, who gave $10,000 (Olliffe Memorial).

One of the features of the new arrangement is the LABORATORY, which is under the direction of Dr. John E. Weeks.

A light, well ventilated room has been set aside for laboratory purposes, newly fitted up with appliances for the study of the normal and pathological histology of the eye. A number of microtomes and a full line of apparatus for work in bacteriology have been supplied. There is also to be a room arranged for the purposes of micro-photography, the apparatus for which has been imported.

It is intended that the work in the laboratory will form an integral part of the work of the Infirmary. The microscopical examination of tissues removed by operation on all patients will be made here, and the results will be added to the histories of the cases.

It is proposed to preserve the specimens that come to hand, so as to form a valuable permanent collection, which will aid in the study of the various forms of eye disease.

Provision has been made for the accommodation of six students. Systematic instruction will be given by Dr. Weeks.

Besides some smaller legacies and donations (one of $2,000 from its old surgeon and generous patron, Dr. Abram Dubois), the Infirmary has received $25,000 from the Fayerweather estate, in the shape of five endowed beds at $5,000 each.

The late Mr. Fayerweather left in his will, $25,000 to the **Manhattan Eye and Ear Hospital.** The will was contested, but a settlement was effected and the Hospital is to get $50,000. Two other legacies, one of $3,000 and one of $1,000, have been left this Institution within a short time, the larger one by Mr. Thomas Hope.

Obituary.

Dr. V. F. SZOKALSKI,

whose name is frequently met with in the French literature of the period immediately before the invention of the ophthalmoscope, died January 6, 1891, at Warsaw. He was born in 1811, and made his studies in Warsaw, Heidelberg, Würtzburg, and Paris. He was chief of clinique of Sichel, and published many papers in the *Annales d'Oculistique*. His courses at the Ecole Pratique were well attended, among others also by A. v. Gräfe. Since 1853 he lived in his native country, at first in Cracow, then in Warsaw as Professor of Physiology, Opthalmology, and Otology. Among his contributions to Opthalmology we may mention those on the Corneal Leucomas, the Diphtheritic Ophthalmia, the Senile Visual Disturbances, the Functions of the Mucous Membranes of the Eye, and the Cerebral Visual Disturbances.

H. K.

Dr. MARTIN, of marseilles,

died in January, 1891. He was a fertile writer, well-known to every oculist who has followed modern ophthalmological literature. He founded an important Ophthalmic Clinque which will be conducted in the same spirit by his son-in-law, Dr. Changarnier.

H. K.

Dr. EDW. MICHAËLIS,

born in Berlin 1824; died there January 15, 1891. He was an assistant of v. Gräfe's from 1851–1862, and one of his most devoted friends. He helped in perpetuating v. Gräfe's memory by his monograph: "A. v. Gräfe, his Life and Work," 1877.

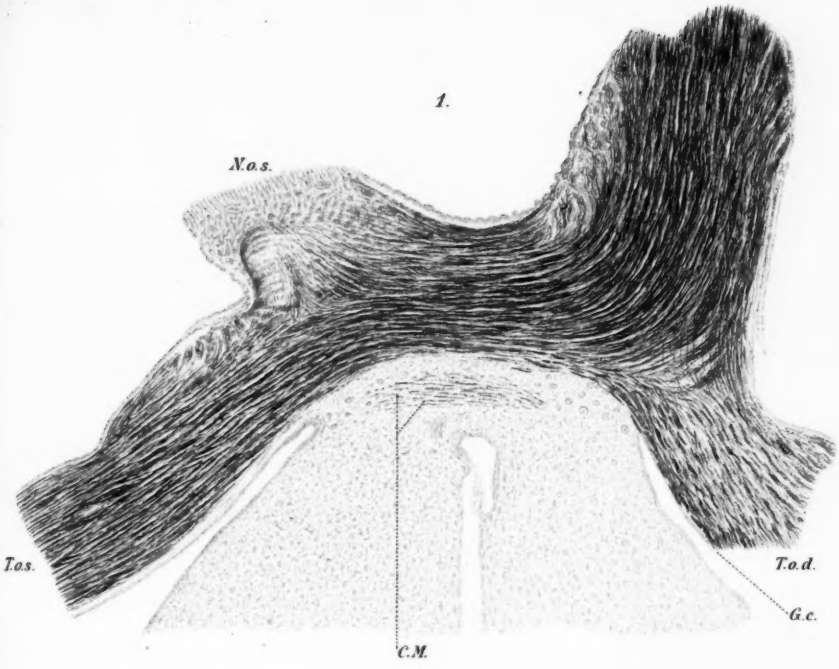
H. K.

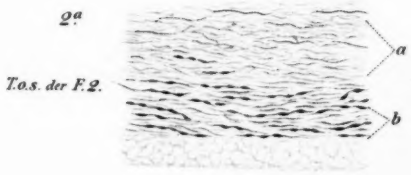
Dr. E. WARLOMONT

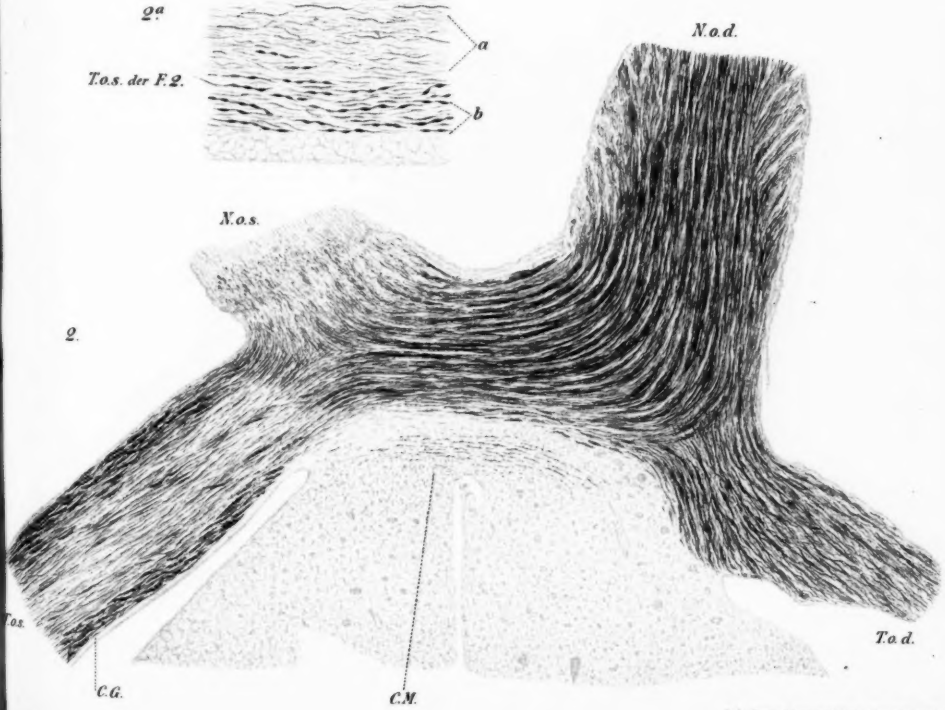
died at Brussels January 22, 1891, at the age of 70 years. Since 1850 he was the editor of the *Annales d'Oculistique.* He took up this journal in rather a precarious condition, but raised it to one of the most esteemed periodicals of its kind. His "elegant pen" was devoted more to comprehensive reviews and the diffusion of knowledge than to the promulgation of his own investigations; yet these comprehensive articles were not without a personal stamp. In 1857 he inaugurated at Brussels the first international Congress of Ophthalmology. The translation of Mackenzie's classical text-book into French, which he made in conjunction with Dr. Testelin, rendered a great service to French and German oculists not familiar with the English language. In the youth of modern ophthalmology, when, after Helmholtz's immortal invention ophthalmology took the lead in medical progress, he never failed at the Heidelberg meetings, and was a conspicuous personage even at the side of Gräfe, Donders, Arlt, Bowman, and Critchett. In one respect he fundamentally differed from his great colleagues. Devoting his time and energy to hospital patients, literary and scientific pursuits, he *hated private practice.* His vivacity, eloquence, and refined manners will never be forgotten by those who had the good fortune of making his personal acquaintance. H. K.

Dr. GEO. R. CUTTER,

since 1877 Surgeon to the N. Y. Eye and Ear Infirmary, died February 12, 1891. He was a gifted and scholarly man, faithful in the discharge of his duty, kind to his patients, and a competent practitioner. H. K.





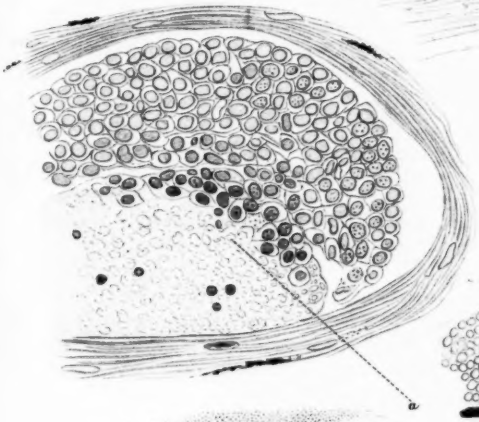


Lith Anst v Werner & Winter Frankfurt a/M

Fig. 1.

Fig. 3.

Fig. 4.



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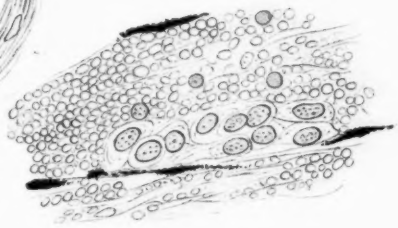

Fig. 2.

Fig. 6.

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Fig. 1.

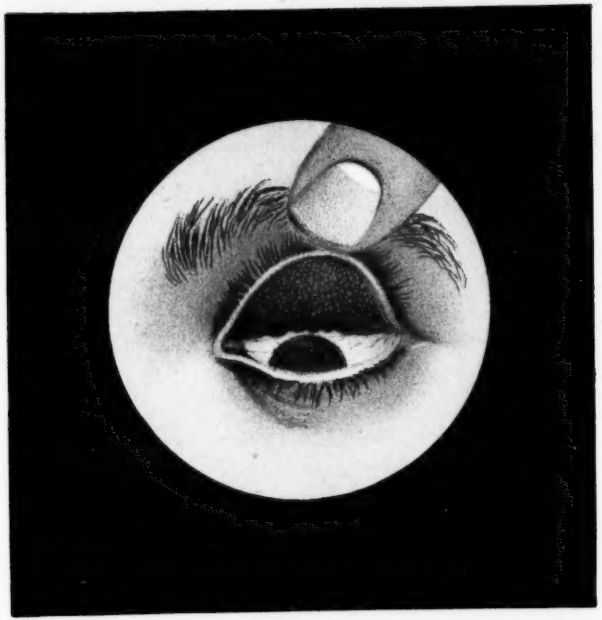
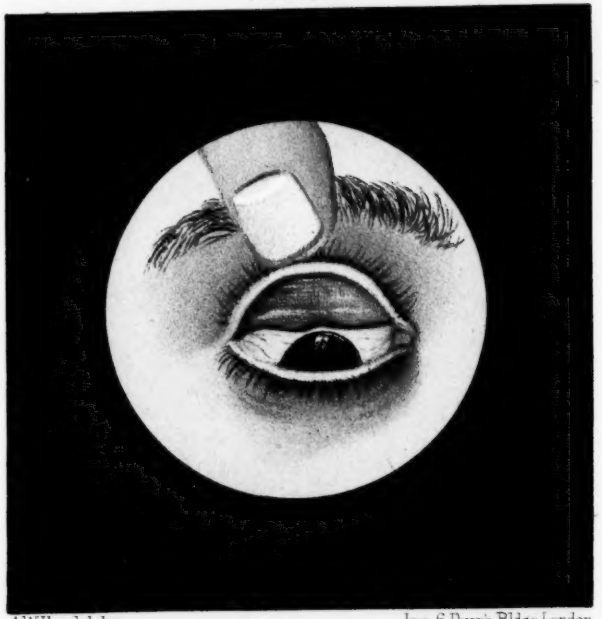


Fig. II.



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